Version 2.5

SmartSensor

SmartSensor User Manual

AX-3D/AX-3DS/HI-INC/AX-3D XRange/HI-INC XRange

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1. TECHNICAL SUPPORT

For general contact, technical support, to report documentation errors and to order manuals, contact ***BeanAir Technical Support Center*** (BTSC) at:
tech-support@beanair.com

For detailed information about where you can buy the BeanAir equipment/software or for recommendations on accessories and components visit:

www.beanair.com

To register for product news and announcements or for product questions contact BeanAir's Technical Support Center (BTSC).

Our aim is to make this user manual as helpful as possible. Please keep us informed of your comments and suggestions for improvements. BeanAir appreciates feedback from the users.

2. VISUAL SYMBOLS DEFINITION

Symbols	Definition
	***Caution or Warning** – Alerts the user with important information about BeanAir wireless sensor networks (WSN), if this information is not followed, the equipment /software may fail or malfunction.*
	***Danger** – This information MUST be followed if not you may damage the equipment permanently or bodily injury may occur.*
	***Tip or Information** – Provides advice and suggestions that may be useful when installing BeanAir Wireless Sensor Networks.*

3. ACRONYMS AND ABBREVIATIONS

AES	Advanced Encryption Standard
CCA	Clear Channel Assessment
CSMA/CA	Carrier Sense Multiple Access/Collision Avoidance
GTS	Guaranteed Time-Slot
kSps	Kilo samples per second
LLC	Logical Link Control
LQI	Link quality indicator
LDCDA	Low duty cycle data acquisition
MAC	Media Access Control
PAN	Personal Area Network
PER	Packet error rate
RF	Radio Frequency
SD	Secure Digital
WSN	Wireless sensor Network

4. RELATED DOCUMENTS & VIDEOS

In addition to this User manual, please consult the related application notes, technical notes and videos:

4.1 APPLICATIONS NOTES

Document name (Click on the weblink)	*Related product*	*Description*
AN_RF_007 :" Beanair_WSN_Deployment"	All BeanAir products	Wireless sensor networks deployment guidelines
AN_RF_006 – „How to extend your wireless range"	All BeanAir products	A guideline very useful for extending your wireless range
AN_RF_005 – BeanGateway® & Data Terminal Equipment Interface	BeanGateway®	DTE interface Architecture on the BeanGateway®
AN_RF_004 – "Coexistence And Interferences@2.4GHz"	All BeanAir products	Coexistence & interferences of different RF technologies in the 2.4 GHz frequencies band.
AN_RF_003 - "IEEE 802.15.4 2.4 GHz Vs 868 MHz"	All BeanAir products	Comparison between 868 MHz frequency band and a 2.4 GHz frequency band.
AN_RF_002 – "Structural Health monitoring on bridges"	All BeanAir products	The aim of this document is to overview Beanair® products suited for bridge monitoring, their deployment, as well as their capacity and limits by overviewing various data acquisition modes available on each BeanDevice®.

4.2 TECHNICAL NOTES

Document name (Click on the weblink)	*Related product*	*Description*
TN_RF_010 – « BeanDevice® Power Management »	All the BeanDevice®	This technical note describes the sleeping & active power mode on the BeanDevice®.
TN_RF_009 – « BeanGateway® management on LAN infrastructure »	BeanGateway®	BeanGateway® integration on a LAN infrastructure
TN_RF_008 – "Data acquisition modes available on the BeanDevice®"	All the BeanDevice®	Data acquisition modes available on the BeanDevice®
TN_RF_007 – "BeanDevice® DataLogger User Guide "	All the BeanDevice®	This document presents the DataLogger feature on the BeanDevice®
TN_RF_006 – "WSN Association process"	All the BeanDevice®	Description of the BeanDevice® network association
TN_RF_005 – "Pulse counter & binary data acquisition on the BeanDevice® SUN-BN"	BeanDevice® SUN-BN	This document presents Pulse counter (ex: energy metering application) and binary data acquisition features on the BeanDevice® SUN-BN.
TN_RF_004 - Ambient Light sensor technical specifications	BeanDevice® SUN-XX (Ecosensor)	Technical description of the Ambient light sensor available on the BeanDevice® SUN-XX products
RF_TN_003- "Aggregation capacity of wireless sensor networks"	All the products	Network capacity characterization of Beanair Wireless Sensor Networks
RF_TN_002 V1.0 - Current consumption in active & sleeping mode	BeanDevice®	Current consumption estimation of the BeanDevice in active and sleeping mode
RF_TN_001 V1.0- Wireless range benchmarking	BeanDevice®	Wireless range benchmarking of the BeanDevice®

4.3 RELATED VIDEOS

All the videos are available on our Youtube channel

Beanair video link (Youtube)	Related products
Company Presentation	All
BeanGateway® - Ethernet Outdoor version introduction	BeanGateway® - Ethernet Outdoor version introduction
BeanGateway® – Ethernet Indoor version presentation	BeanGateway® Ethernet Indoor version
Beandevice® AN-XX wireless range demonstration	BeanDevice® AN-XX & Beandevice® AN-XX Extender
BeanDevice® AN-XX presentation	BeanDevice® AN-XX & Beandevice® AN-XX Extender
BeanDevice® AX-3D presentation	BeanDevice® AX-3D
BeanDevice® HI-INC presentation	BeanDevice® HI-INC
BeanDevice® AX-3DS presentation	BeanDevice® AX-3DS
BeanScape® – WSN supervision software	BeanScape®
BeanGateway® Ethernet/LAN Configuration, directly connected to the Laptop/PC	BeanGateway®
Performing an energy scan on your BeanGateway®	BeanGateway®
Automatic RF Channel selection	BeanGateway®
Wireless sensors profile deletion from the BeanGateway® Database	All
Network Diagnostic configuration on the BeanGateway®	BeanGateway®
RF Power configuration on the BeanGateway®	BeanGateway®

5. BEANDEVICE® VERSIONS

V (version) related to a major modification of the embedded software.

R (Release) related to a minor modification of the embedded software

	Hardware	*Embedded Software*	*Wireless Stack*
BeanDevice® AX-3D	***V1R2*** : Push button ON/OFF activation ***V1R3***: reed sensor ON/OFF activation	***V4R0 – Time Sync function added***	IEEE 802.15.4 R0
BeanDevice® HI-INC			
BeanDevice® AX-3DS			

These ID versions should be transmitted to our technical support center when you encountered a material or software dysfunction.

6. DOCUMENT ORGANISATION

This manual is organized in 7 chapters, as follows:

BeanDevice® product overview	•Details the BeanDevice® product presentation
Data acquisition mode description	•Details the data acquisition mode available on the BeanDevice® • ***Related Technical Note:*** TN_RF_008 - "Data acquisition mode available on the BeanDevice®"
BeanDevice® installation guidelines	•Details the installation guidelines of the BeanDevice® •***Related Technical Note:*** TN_RF_010 - "Beandevice® Power Management " •***Related Technical Note:*** TN_RF_007- "Beandevice® DataLogger user Guide" •***Related Technical Note:*** TN_RF_006- "Beandevice® wireless network association"
BeanDevice® supervision from the Beanscape®	•Details the BeanDevice® supervision from the BeanScape®
BeanDevice® maintenance & supervision (for experienced user)	•Details the BeanDevice® maintenance (for experienced user)
Troubleshooting	•Frequently asked questions
Installation procedures	•Details the installation procedures

7. BEANDEVICE® PRODUCT DESCRIPTION

- ✓ ***It is highly recommended to read all the user manual related to BeanAir software & equipment (BeanScape ®, BeanGateway®, BeanDevice®) before getting start your BeanDevice®.***
- ✓ ***Use only accessories supplied by BeanAir (batteries, power supply unit, and antenna). Use of other materials may damage the BeanDevice®;***
- ✓ ***Only BeanAir is qualified to make changes on the BeanDevice®;***
- ✓ ***Don't try to remove the adhesive label on the product; it contains important information such as the MAC address or sensor measurement range***

BeanDevice® Smart sensor product lines were designed by our R&D team in order to be adapted for shock, acceleration, vibration, oscillation measurement in harsh industrial environment.

7.1 BEANDEVICE® AX-3D

7.1.1 Featured video

Click here

7.1.2 Main features

Main Features
• Wireless Tri-axis accelerometer based on MEMS Technology • Measurement range: ±2g, ±10g • Very Low noise Density: 45 µg/√Hz (±2g version), 100 µg/√Hz (±10g version), • Excellent radio link thanks to the radio antenna diversity developed by BeanAir® • Maximum sampling rate: 3 KSPS • **TimeSync function :** Time Synchronization through wireless sensor network • Maximum Radio Range : 500 m (L.O.S) • Ultra-Power Radio Technology IEEE 802.15.4 • Current consumption in idle mode : **< 30 uA** • Embedded logger : up to ***1 million*** data points (with events dating) • Entirely autonomous system with an integrated Lithium-Ion battery charger • Anti-aliasing Butterworth filter (***5th order***) with a cut-off frequency of ***1 Hz to 2 KHz*** (remotely programmable from the BeanScape®) • Watertight aluminum enclosure IP66 (dimensions Lxlxh : 80x55x21 mm - weight 145g rechargeable battery included) - suitable for Harsh Industrial Environment

7.1.3 Applications

- ✓ Dynamic measurement on embedded equipment
- ✓ Vibration analysis
- ✓ Inertial measurement

- ✓ Movement and Shock detection
- ✓ Structural health monitoring

7.2 BEANDEVICE® HI-INC (WIRELESS INCLINOMETER)

7.2.1 Featured video

Click here

7.2.2 Main features

BeanDevice® HI-INC:Wireless Inclinometer

Main Features

- Wireless Inclinometer based on MEMS Technology
- Measurement range:
  - mono-axis or bi-axis ±15°
  - mono-axial or bi-axis ±30°
  - bi-axis +/-90°
- Excellent resolution:
  - 0,001° for ±15° & ±30° version
  - 0,0025° for ±90° version
- **TimeSync function :** Time Synchronization through wireless sensor network
- Excellent radio link thanks to the antenna diversity developed by BeanAir®
- Streaming mode: 200 SPS on each channel
- Maximum Radio Range : 500 m (L.O.S)
- Ultra-Power Radio Technology IEEE 802.15.4
- Current consumption in idle mode : **< 30 uA**
- Embedded logger : up to 1 000 000 data acquisition records (with events dating)
- Entirely autonomous system with an integrated Lithium-Ion battery charger
- Anti-aliasing Butterworth filter (5^{th} order) with a cut-off frequency of 1 Hz to 2 KHz (remotely programmable from the BeanScape®)
- Watertight Aluminium enclosure IP66
- Dimensions LxWxH : 80x55x21 mm—weight 145g (rechargeable battery included) -suitable for Harsh Industrial Environment

7.2.3 Applications

- ✓ Platform Leveling and stabilization
- ✓ Laser level rotation
- ✓ Slope measurement (Building, infrastructure & construction)
- ✓ Oil drilling
- ✓ Axial rotor measurement

7.3 BEANDEVICE® AX-3DS (WIRELESS SHOCK SENSOR)

7.3.1 Featured video

Click here to see our featured video

7.3.1 Main features

Main Features
• Wireless tri-axis accelerometer • Scalable measurement range (two versions) : ***±6g/±12g/±24g or ±2g/±4g/±8g*** • Excellent radio link thanks to the antenna diversity developed by Beanair® • Advanced and smart shock detection • Non contact actuation for faster installation • Maximum sampling rate: 3 KSPS (maximum) • Maximum radio range : 500 m (L.O.S) • Ultra-Low Power Radio Technology IEEE 802.15.4 • Current consumption during deep sleeping mode : < 28 uA • ***Embedded Data Logger*** : up to ***1 million*** data points • Entirely autonomous system with an integrated Lithium-Ion battery charger • ***Watertight aluminium enclosure IP66*** (dimensions LxWxH : 80x55x21mm)—weight 135g (rechargeable battery included) -suitable for Harsh Industrial Environment

7.3.2 Applications

- ✓ Health and usage monitoring systems (HUMS)
- ✓ Shock measurement on vehicles & trains
- ✓ Transportation Monitoring
- ✓ Drop testing
- ✓ Crash and impact testing
- ✓ Ride Quality Measurement

7.4 BEANDEVICE® AX-3D XRANGE (HIGH PERFORMANCE WIRELESS ACCELEROMETER)

7.4.1 Featured video

[Watch our fetaured video]

7.4.2 Main features

Main Features
▪ Wireless Tri-axis accelerometer based on MEMS Technology ▪ Measurement range (2 versions): ±2g & ±10g ▪ Very Low noise Density: ○ 45 µg/√Hz (± 2g version) ○ 100 µg/√Hz (± 10g version) ▪ **TimeSync function :** Time Synchronization through wireless sensor network ▪ Watertight IP67 aluminum enclosure coming with a rugged base plate and three-point-mounting ▪ Excellent radio link relying on the radio antenna diversity developed by Beanair® ▪ Non contact actuation for quick mounting ▪ Maximum sampling rate: 4 KSPS ▪ Maximum Radio Range : 650 m (L.O.S) ▪ Ultra-Power radio technology IEEE 802.15.4 ▪ Current consumption in sleeping mode : < 30 µA ▪ Embedded data logger : up to ***8 millions*** data points ▪ OPC server allowing real time access from your IT system to the BeanScape® (available on BeanScape® Premium+) ▪ Entirely autonomous system with an integrated Lithium-Ion battery charger ▪ Anti-aliasing Butterworth filter (5th order) with a cut-off frequency of 1 Hz to 2 KHz (remotely programmable from the BeanScape®) ▪ Free Scilab scripts for FFT and PPV filtering ▪ Fully calibrated sensor

7.5 BEANDEVICE® HI-INC XRANGE (HIGH PERFORMANCE WIRELESS INCLINOMETER)

7.5.1 Main features

Main Features	
▪ Wireless Inclinometer based on MEMS Technology ▪ Measurement range: ±15° & ±30° (mono-axis & bi-axis) ▪ Excellent resolution (0.001°) & accuracy (±0.05°) ▪ Temperature compensated sensor ▪ Excellent radio link thanks to the antenna diversity developed by Beanair® ▪ Non contact actuation for quick mounting ▪ Maximum sampling rate: 200 SPS ▪ Maximum radio range : 650m (L.O.S) ▪ Ultra-Power Radio Technology IEEE 802.15.4 ▪ Current consumption in sleeping mode : < 30 µA ▪ Embedded data Logger : up to ***8 millions*** data points ▪ OPC server allowing real time access from your IT system to the BeanScape® (available on **BeanScape® Premium+**) ▪ Entirely autonomous system with an integrated Lithium-Ion battery charger ▪ Watertight IP67 aluminum enclosure coming with a rugged base plate and three-point-mounting ▪ Anti-aliasing Butterworth filter (5th order) with a cut-off frequency of 1 Hz to 100Hz (remotely programmable from the BeanScape®) ▪ Fully calibrated sensor	

7.6 TECHNICAL SPECIFICATIONS

7.6.1 Beandevice® AX-3D

Product reference	
BND-AX3D -*MR*G –*WP*	
MR – ***Measurement Range***: ***2*** : ±2g measurement range ***10*** : ±10g measurement range ***13***: ±13g measurement range	***WP– Wireless Technology*** - ***IEEE*** : IEEE 802.15.4 (2006)
Example: BND-AX3D-10G-IEEE—Wireless Accelerometer with 10g measurement range , IEEE 802.15.4 Wireless Technology	

	Accelerometer Specifications
Accelerometer technology	MEMS technology triaxial accelerometer
Sensitivity	±2g Version : 16384 counts/g ±10g version: 3277 counts/g ±13g version: 2521 counts/g
Typical non-linearity	±0.1% FS
Analog to Digital converter	16-bits, SAR architecture (Successive Approximation Register) with temperature compensation
Sensor frequency response (-3 dB)	0 to 800 Hz
Noise spectral density	±2g Version : 45 µg/√Hz ±10g version: 100 µg/√Hz ±13g version: 100 µg/√Hz
Zero-g Offset Variation from RT over Temp	±2g Version : ±0.2 mg/°C ±10g version: ±0.1 mg/°C ±13g version: ±0.1 mg/°C
Sensitivity Variation from RT over Temp	±2g Version : ±0.01 %/°C (XY) , ±0.02 %/°C (Z) ±10g version: ±0.01 %/°C ±13g version: ±0.01 %/°C
Offset Ratiometric Error	±2g Version : 4mg ±10g version: ±0.2% (XY) , ±0.1% (Z) ±13g version: ±0.5%
Sensitivity Ratiometric Error	±2g Version : ±1.25 % (X-Y) , ±0.2 % (Z) ±10g Version : ±1.6% (X-Y) , ±0.2 % (Z) ±13g Version : ±1.6% (X-Y) , ±0.2 % (Z)
Cross Axis Sensitivity	2%

Anti-aliasing filter	Butterworth 5th order filter – cut-off frequency : 1 Hz to 2000 Hz remotely programmable (BeanScape®)

	Over-the-air configuration (OTAC) parameters
Data Acquisition mode (**SPS** = sample per second)	Low Duty Cycle Data Acquisition (LDCDA) Mode: 1s to 24 hour Alarm & Survey mode: 1s to 24 hour Streaming Packet Mode Streaming Mode
Sampling Rate (in streaming packet mode)	Minimum: 1 SPS Maximum: 3 kSPS per axis (one axis activated) 1,5 kSPS per axis (2-axis activated) 1 kSPS per axis (3-axis activated)
Alarm Threshold	2 high levels alarms & 2 low levels alarms
Programmable Cut-off frequency (Anti-aliasing filter)	1– 2000 Hz
Power Mode	Sleeping, Sleeping with Network Listening & Active
TX Power	-7 dBm / -1 dBm / 5 dBm / 11 dBm / 15 dBm / 18 dBm

	RF Specifications
Wireless Protocol Stack	IEEE 802.15.4 (2006 version)
WSN Topology	Point-to-Point / Star
Encryption	AES 128 bits (AES integrated coprocessor)
Data rate	250 Kbits/s
RF Characteristics	ISM 2.4GHz – 16 Channels. Antenna diversity architecture designed by Beanair®
TX Power	+0 dBm to +18 dBm
Receiver Sensitivity	-95.5 dBm to -104 dBm
Maximum Radio Range	300m (L.O.S)
Antenna	Antenna diversity : 2 omnidirectional antenna with a gain of 2,2 dBi

	Embedded Data logger
Storage capacity	up to 1 000 000 data acquisition
Write/read cycle	400 000
Wireless data downloading	3 minutes to download the full memory (average time)

	Real Time clock and crystal
Real Time Clock	Extremely Accurate Real Time Clock for measurement time stamping in Low duty cycle mode (±10ppm)

Crystal	Extremely accurate crystal for measurement time stamping in streaming & streaming packet mode Tolerance ±10ppm, stability ±10ppm

	Environmental and Mechanical
Enclosure	Aluminium & Watertight (IP66) enclosure Dimensions in mm (LxWxH): 80x55x21 mm, Weight (battery included) : 145g
Shock resistance	100g during 50 ms
Operating Temperature	-20 °C to +65 °C
Norms	CE Labelling Directive R&TTE (Radio) ETSI EN 300 328 ROHS - Directive 2002/95/EC

	Power supply
Integrated battery charger	Integrated Lithium-ion battery charger with high precision battery monitoring : · Overvoltage Protection, Overcurrent/Short-Circuit Protection, Undervoltage Protection · Battery Temperature monitoring · Current accumulation measurement
Current consumption @ 3,3V	· During data acquisition : 20 to 30 mA · During Radio transmission : 40 mA @ 0dBm , 80 mA @ 18 dBm · During sleeping : < 30 µA
External power supply	External power supply : +8v to +28v
Rechargeable battery	High density Lithium-Ion rechargeable battery with a capacity of 1.3 Ah (referenced as BAT1.3DMG)

	Option(s)
Power-supply bloc	Wall plug-in, Switchmode power Supply 12V @ 1,25A with sealed M8 Plug (IP67)
Calibration certificate	Calibration certificate provided by Beanair A static calibration method is used on a granite surface plate DIN876

7.6.2 Beandevice® AX-3DS

Product reference	
BND-AX3DS -*MR*G-*PS*-*WP*	
MR – ***Measurement Range***: ***24*** : ±6/12/24g measurement range ***8*** : ±2/4/8g measurement range	***PS*** - ***Power supply*** : ***RB*** : Rechargeable battery ***XT*** : External Primary cell
	WP– Wireless Technology : ***IEEE*** : IEEE 802.15.4 (2006)
Example: BND-AX3DS-24G-RB-IEEE—Wireless Accelerometer with ±6/12/24g measurement range , rechargeable battery, IEEE 802.15.4 Wireless Technology	

	Sensor specifications
Accelerometer Technology	MEMS Technology
Scalable measurement range	BND-AX3DS –24G-RB-IEEE Version : ±6g / ±12g/ ±24g BND-AX3DS –8G-RB-IEEE Version ±2g / ±4g/ ±8g The measurement range is remotely programmable (BeanScape®)
Measurement resolution	BND-AX3DS –24G-IEEE Version : 3 mg/digit @±6g , 6 mg/digit @±12g , 12 mg/digit @±24g BND-AX3DS –8G-IEEE Version : 1mg/digit @±2g , 2 mg/digit @±4g , 3.9 mg/digit @±8g
Typical non-linearity	±0,15%
Sensitivity change Vs temperature	±0,01% /°C
Zero-g level change vs temperature (max delta from 25°C)	BND-AX3DS –24G-IEEE Version: ±0,4 mg/°C BND-AX3DS –8G-IEEE Version : ±0,1 mg/°C
Typical zero-g level offset accuracy	BND-AX3DS –24G-IEEE Version: ±70 mg BND-AX3DS –8G-IEEE Version: ±20 mg
Analog to Digital converter	12-bits with temperature compensation
Noise spectral density @ BW 10Hz	BND-AX3DS –24G-IEEE Version : 650 µg/ √Hz BND-AX3DS –8G-IEEE Version : 218 µg/ √Hz
Anti-aliasing filter	Butterworth 2th order filter

	Over-the-air configuration (OTAC) parameters
Data Acquisition mode (SPS = sample per second)	Low Duty Cycle Data Acquisition (LDCDA) Mode: 1s to 24 hour Alarm & Survey mode: 1s to 24 hour Streaming Packet Mode Streaming Mode Shock detection
Shock detection function	· Shock threshold in mg · Data acquisition sample rate in sleeping mode · Data acquisition sample rate after the shock detection · Shock detection hysteresis
Sampling Rate (in streaming packet mode)	Minimum: 1 SPS Maximum: 3 kSPS per axis (one axis activated) 1,5 kSPS per axis (2-axis activated) 1 kSPS per axis (3-axis activated)
Alarm Threshold	2 high levels alarms & 2 low levels alarms
Power Mode	Sleeping, Sleeping with Network Listening & Active
TX Power	-7 dBm / -1 dBm / 5 dBm / 11 dBm / 15 dBm / 18 dBm

	RF Specifications
Wireless Protocol Stack	IEEE 802.15.4 (2006 version)
WSN Topology	Point-to-Point / Star
Encryption	AES 128 bits (AES integrated coprocessor)
Data rate	250 Kbits/s
RF Characteristics	ISM 2.4GHz – 16 Channels. Antenna diversity architecture designed by Beanair®
TX Power	+0 dBm to +18 dBm
Receiver Sensitivity	-95.5 dBm to -104 dBm
Maximum Radio Range	300m (L.O.S)
Antenna	Antenna diversity : 2 omnidirectional antenna with a gain of 2,2 dBi

	Embedded Data logger
Storage capacity	up to 1 000 000 data acquisition
Write/read cycle	400000
Wireless data downloading	3 minutes to download the full memory (average time)

	Real Time clock and crystal
Real Time Clock	Extremely Accurate Real Time Clock for measurement time stamping in Low duty cycle mode (±10ppm)
Crystal	Extremely accurate crystal for measurement time stamping in streaming & streaming packet mode
	Tolerance ±10ppm, stability ±10ppm

	Environmental and Mechanical
Enclosure	Aluminium & Watertight (IP66) enclosure Dimensions in mm (LxWxH): 80x55x21 mm, Weight (battery included) : 145g
Shock resistance	100g during 50 ms
Operating Temperature	-20 °C to +65 °C
Norms	CE Labelling Directive R&TTE (Radio) ETSI EN 300 328 ROHS - Directive 2002/95/EC

	Power supply
Integrated battery charger	Integrated Lithium-ion battery charger with high precision battery monitoring : · Overvoltage Protection, Overcurrent/Short-Circuit Protection, Undervoltage Protection · Battery Temperature monitoring · Current accumulation measurement
Current consumption @3,3V	· During data acquisition : 20 to 30 mA · During Radio transmission : 40 mA @ 5dBm , 70 mA @ 18 dBm · During sleeping mode: 68uA · During deep sleeping mode : 28 uA
External power supply	External power supply : +8v to +28v
Rechargeable battery	High density Lithium-Ion rechargeable battery with a capacity of 1.3 Ah (referenced as BAT1.3DMG)

	Option(s)
Power-supply bloc	Wall plug-in, Switchmode power Supply 12V @ 1,25A with sealed M8 Plug (IP67)

7.6.3 Beandevice® HI-INC

Product reference	
BND-HI-INC-*MR*-*PS*-*WP*	
MR*– *Measurement Range: ***15M*** : mono-axial ±15° ***15B*** : bi-axial ±15° ***30M*** : mono-axial ±30° ***30B*** : bi-axial ±30°	***PS*** - ***Power supply*** : ***RB*** : Internal rechargeable battery ***XT*** : External Primary cell ***WP– Wireless Technology :*** ***IEEE*** : IEEE 802.15.4 (2006)
Example 1: **BND-HI-INC-15B-RB-IEEE**-wireless bi-axial inclinometer with ±15° measurement range, internal rechargeable battery, IEEE 802.15.4 wireless Technology ***Example 2***: **BND-HI-INC-30M-XT-IEEE**-wireless mono-axial inclinometer with ±30° measurement range, external primary cell, IEEE 802.15.4 wireless Technology	

	Sensor specifications
Inclinometer Technology	Inclinometer based on MEMS Technology
Measurement resolution (Bandwidth 10 Hz)	0.001°
Noise density	0.0004 °/√Hz
Accuracy (Full scale)	±0.05°
Offset temperature dependency (temperature range –25°C to +85°C)	±0.002 °/°C
Sensitivity temperature dependency (temperature range –25°C to +85°C)	±0.005 %/°C with temperature compensation
	±0.013 %/°C without temperature compensation
Long term stability (@23°C)	< 0.004 °
Analog to Digital converter	16-bits, SAR architecture (Successive Approximation Register) with temperature compensation
Sensor frequency Response (-3 dB)	DC to 28 Hz
Noise spectral density DC to 100 Hz	0.0004 °/ √Hz
Anti-aliasing filter	Butterworth 5th order filter – cut-off frequency : 1 Hz to 100 Hz remotely programmable (BeanScape®)

	Over-the-air configuration (OTAC) parameters
Data Acquisition mode (SPS = sample per second)	Low Duty Cycle Data Acquisition (LDCDA) Mode: 1s to 24 hour
	Alarm & Survey mode: 1s to 24 hour
	Streaming Packet Mode
	Streaming Mode
Sampling Rate (in streaming packet mode)	Minimum: 1 SPS Maximum: 60 SPS on each axis
Alarm Threshold	2 high levels alarms & 2 low levels alarms
Programmable cut-off frequency (Anti-aliasing filter)	1– 100 Hz
Power Mode	Sleeping, Sleeping with Network Listening & Active
TX Power	-7 dBm / -1 dBm / 5 dBm / 11 dBm / 15 dBm / 18 dBm

	RF Specifications
Wireless Protocol Stack	IEEE 802.15.4 (2006 version)
WSN Topology	Point-to-Point / Star
Encryption	AES 128 bits (AES integrated coprocessor)
Data rate	250 Kbits/s
RF Characteristics	ISM 2.4GHz – 16 Channels. Antenna diversity architecture designed by Beanair®
TX Power	+0 dBm to +18 dBm
Receiver Sensitivity	-95.5 dBm to -104 dBm
Maximum Radio Range	300m (L.O.S)
Antenna	Antenna diversity : 2 omnidirectional antenna with a gain of 2,2 dBi

	Embedded Data logger
Storage capacity	up to 1 000 000 data acquisition
Write/read cycle	400000
Wireless data downloading	3 minutes to download the full memory (average time)

	Real Time clock and crystal
Real Time Clock	Extremely Accurate Real Time Clock for measurement time stamping in Low duty cycle mode (±10ppm)
Crystal	Extremely accurate crystal for measurement time stamping in streaming & streaming packet mode
	Tolerance ±10ppm, stability ±10ppm

	Environmental and Mechanical
Enclosure	Aluminium & Watertight (IP66) enclosure Dimensions in mm (LxWxH): 80x55x21 mm, Weight (battery included) : 145g
Shock resistance	100g during 50 ms
Operating Temperature	-20 °C to +65 °C
Norms	CE Labelling Directive R&TTE (Radio) ETSI EN 300 328 ROHS - Directive 2002/95/EC

	Power supply
Integrated battery charger	Integrated Lithium-ion battery charger with high precision battery monitoring : · Overvoltage Protection, Overcurrent/Short-Circuit Protection, Undervoltage Protection · Battery Temperature monitoring · Current accumulation measurement
Current consumption @3,3V	· During data acquisition : 20 to 30 mA · During Radio transmission : 40 mA @ 0dBm , 80 mA @ 18 dBm · During sleeping : < 30 µA
External power supply	External power supply : +8v to +28v
Rechargeable battery	High density Lithium-Ion rechargeable battery with a capacity of 950 mAh (referenced as BAT0.95DMG)

	Option(s)
Power-supply bloc	Wall plug-in, Switchmode power Supply 12V @ 1,25A with sealed M8 Plug (IP67)
Calibration certificate	Calibration certificate provided by Beanair A static calibration method is used on a granite surface plate DIN876

7.6.4 Beandevice® AX-3D XRange

Product reference	
BND-AX3D -***MRG-XR-WP***	
MR – ***Measurement Range***: ***2*** : ±2g measurement range ***10*** : ±10g measurement range ***13***: ±13g measurement range	***WP– Wireless Technology*** - ***IEEE*** : IEEE 802.15.4 (2006)
Example: BND-AX3D-10G-XR-IEEE—High performance wireless accelerometer with 10g measurement range , IEEE 802.15.4 Wireless Technology	

	Accelerometer Specifications
Accelerometer technology	MEMS technology triaxial accelerometer
Sensitivity	±2g Version : 16384 counts/g ±10g version: 3277 counts/g ±13g version: 2521 counts/g
Typical non-linearity	±0.1% FS
Analog to Digital converter	16-bits, SAR architecture (Successive Approximation Register) with temperature compensation
Sensor frequency response (-3 dB)	0 to 800 Hz
Noise spectral density	±2g Version : 45 µg/√Hz ±10g version: 100 µg/√Hz ±13g version: 100 µg/√Hz
Zero-g Offset Variation from RT over Temp	±2g Version : ±0.2 mg/°C ±10g version: ±0.1 mg/°C ±13g version: ±0.1 mg/°C
Sensitivity Variation from RT over Temp	±2g Version : ±0.01 %/°C (XY) , ±0.02 %/°C (Z) ±10g version: ±0.01 %/°C ±13g version: ±0.01 %/°C
Offset Ratiometric Error	±2g Version : 4mg ±10g version: ±0.2% (XY) , ±0.1% (Z) ±13g version: ±0.5%
Sensitivity Ratiometric Error	±2g Version : ±1.25 % (X-Y) , ±0.2 % (Z) ±10g Version : ±1.6% (X-Y) , ±0.2 % (Z) ±13g Version : ±1.6% (X-Y) , ±0.2 % (Z)
Cross Axis Sensitivity	2%
Anti-aliasing filter	Butterworth 5th order filter – cut-off frequency : 1 Hz to 2000 Hz remotely programmable (BeanScape®)

	Over-the-air configuration (OTAC) parameters
Data Acquisition mode (SPS = sample per second)	Low Duty Cycle Data Acquisition (LDCDA) Mode: 1s to 24 hour Alarm & Survey mode: 1s to 24 hour Streaming Packet Mode Streaming Mode
Sampling Rate (in streaming packet mode)	Minimum: 1 SPS Maximum: 3 kSPS per axis (one axis activated) 1,5 kSPS per axis (2-axis activated) 1 kSPS per axis (3-axis activated)
Sampling Rate (in streaming packet mode with data logger only)	Minimum: 1 SPS Maximum: 4 kSPS maximum per axis (one or two axis activated) 3,5 kSPS per axis (3-axis activated)
Alarm Threshold	2 high levels alarms & 2 low levels alarms
Programmable Cut-off frequency (Anti-aliasing filter)	1– 2000 Hz
Power Mode	Sleeping, Sleeping with Network Listening & Active
TX Power	-7 dBm / -1 dBm / 5 dBm / 11 dBm / 15 dBm / 18 dBm

	RF Specifications
Wireless Protocol Stack	IEEE 802.15.4 (2006 version)
WSN Topology	Point-to-Point / Star
Encryption	AES 128 bits (AES integrated coprocessor)
Data rate	250 Kbits/s
RF Characteristics	ISM 2.4GHz – 16 Channels. Antenna diversity architecture designed by Beanair®
TX Power	+0 dBm to +18 dBm
Receiver Sensitivity	-95.5 dBm to -104 dBm
Maximum Radio Range	390m (L.O.S)
Antenna	Antenna diversity : 2 omnidirectional antenna with a gain of 3dBi

	Embedded data logger
Storage capacity	up to 8 000 000 data acquisition
Write/read cycle	400 000
Wireless data downloading	5 minutes to download the full memory (average time)

	Real Time clock and crystal
Real Time Clock	Extremely Accurate Real Time Clock for measurement time stamping in Low duty cycle mode (±10ppm)

Crystal	Extremely accurate crystal for measurement time stamping in streaming & streaming packet mode Tolerance ±10ppm, stability ±10ppm

	Environmental and Mechanical
Enclosure	· Aluminum & Watertight (IP66) enclosure · Dimensions in mm (LxWxH): 100 x 71 x 30 (135 x 71 x 30 with antennas), Weight (battery included) : 165g
Base plate	· Aluminum black anodized AL 7075 with rugged three-point-mounting · The sensor module is to be mounted on a flat and smooth surface with 3 screws, dimension M5. Mounting torque 5 ±1Nm
Shock resistance	200g during 50 ms
Operating Temperature	-20 °C to +65 °C
Norms	CE Labelling Directive R&TTE (Radio) ETSI EN 300 328 ROHS - Directive 2002/95/EC

	Power supply
Integrated battery charger	Integrated Lithium-ion battery charger with high precision battery monitoring : · Overvoltage Protection, Overcurrent/Short-Circuit Protection, Undervoltage Protection · Battery Temperature monitoring · Current accumulation measurement
Current consumption @ 3,3V	· During data acquisition : 20 to 30 mA · During Radio transmission : 40 mA @ 0dBm , 80 mA @ 18 dBm · During sleeping : < 30 µA
External power supply	External power supply : +8v to +28v
Rechargeable battery	High density Lithium-Ion rechargeable battery with a capacity of 1550 mAh (referenced as BAT1.55DMG)

	Option(s)
Power-supply bloc	Wall plug-in, Switchmode power Supply 12V @ 1,25A with sealed M8 Plug (IP67)
Calibration certificate	Calibration certificate provided by Beanair A static calibration method is used on a granite surface plate DIN876

7.6.5 Beandevice® HI-INC XRange

Product reference	
BND-HI-INC-*MR*-XR-*PS-WP*	
MR*– *Measurement Range: ***15M*** : mono-axial ±15° ***15B*** : bi-axial ±15° ***30M*** : mono-axial ±30° ***30B*** : bi-axial ±30°	***PS*** - ***Power supply*** : ***RB*** : Internal rechargeable battery ***XT*** : External Primary cell ***WP– Wireless Technology :*** ***IEEE*** : IEEE 802.15.4 (2006)
Example 1: **BND-HI-INC-15B-XR-RB-IEEE,** High performance wireless bi-axial inclinometer with ±15° measurement range, internal rechargeable battery, IEEE 802.15.4 wireless Technology ***Example 2***: **BND-HI-INC-30M-XR-XT-IEEE,** High performance wireless mono-axial inclinometer with ±30° measurement range, external primary cell, IEEE 802.15.4 wireless Technology	

	Sensor specifications
Inclinometer Technology	Inclinometer based on MEMS Technology
Measurement resolution (Bandwidth 10 Hz)	0,001°
Noise density	0.0004 °/√Hz
Accuracy (Full scale)	±0.05°
Offset temperature dependency (temperature range –25°C to +85°C)	±0.002 °/°C
Sensitivity temperature dependency (temperature range –25°C to +85°C)	±0.005 %/°C with temperature compensation
	±0.013 %/°C without temperature compensation
Long term stability (@23°C)	< 0.004 °
Analog to Digital converter	16-bits, SAR architecture (Successive Approximation Register) with temperature compensation
Sensor frequency Response (-3 dB)	DC to 28 Hz
Noise spectral density DC to 100 Hz	0.0004 °/ √Hz
Anti-aliasing filter	Butterworth 5th order filter – cut-off frequency : 1 Hz to 100 Hz remotely programmable (BeanScape®)

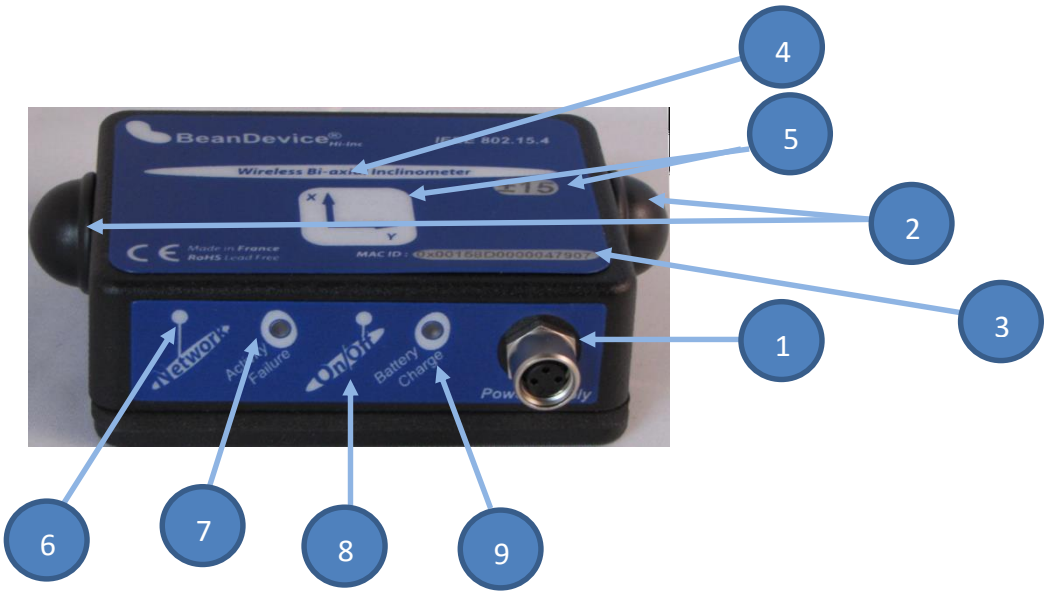
	Environmental and Mechanical
Enclosure	· Aluminum & Watertight (IP66) enclosure · Dimensions in mm (LxWxH): 100 x 71 x 30 (135 x 71 x 30 with antennas), Weight (battery included) : 165g
Base plate	· Aluminum black anodized AL 7075 with rugged three-point-mounting · The sensor module is to be mounted on a flat and smooth surface with 3 screws, dimension M5. Mounting torque 5 ±1Nm
Shock resistance	200g during 50 ms
Operating Temperature	-20 °C to +65 °C
Norms	CE Labelling Directive R&TTE (Radio) ETSI EN 300 328
	ROHS - Directive 2002/95/EC

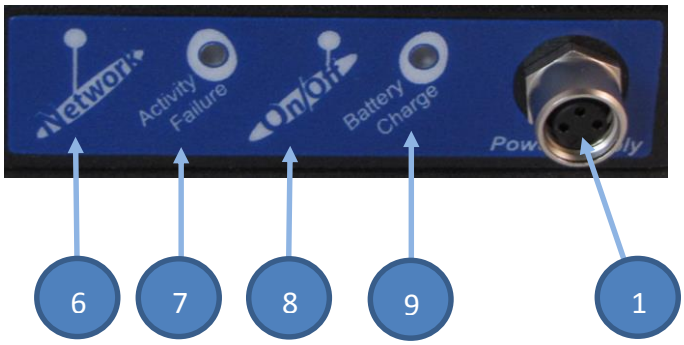
	Power supply
Integrated battery charger	Integrated Lithium-ion battery charger with high precision battery monitoring : · Overvoltage Protection, Overcurrent/Short-Circuit Protection, Undervoltage Protection · Battery Temperature monitoring · Current accumulation measurement
Current consumption @3,3V	· During data acquisition : 20 to 30 mA · During Radio transmission : 40 mA @ 0dBm , 80 mA @ 18 dBm · During sleeping : < 30 µA
External power supply	External power supply : +8v to +28v
Rechargeable battery	High density Lithium-Ion rechargeable battery with a capacity of 1.35 Ah (referenced as BAT1.35DMG)

	Option(s)
Power-supply bloc	Wall plug-in, Switchmode power Supply 12V @ 1,25A with sealed M8 Plug (IP67)
Calibration certificate	Calibration certificate provided by Beanair A static calibration method is used on a granite surface plate DIN876

7.7 PRODUCT FOCUS

7.7.1 Casing description





Number	Function	Description
1	M8-3 Contacts Socket for power supply input	***DC 8-28 volts*** power supply. The socket sealing is assured with a screw cap. ***If you don't use the external power supply, don't forget to protect the M8-3 pins socket with a M8 protection cap.***
2	Radome antenna	Waterproof IP67 Radome antenna
3	MAC ID Label	Unique identifier assigned to the BeanDevice® (64-bytes) ***Every wireless network product which is based on the IEEE 802.15.4 standard must have a 64-bit MAC address that allows unique identification of the device within a global network.***
4	BeanDevice® product version label	Three label version are available : ✓ ***BeanDevice® AX-3D****: measurement range and the three axis are indicated on the Label* ✓ ***BeanDevice® HI-INC****: measurement range and the three axis are indicated on the Label* ✓ ***BeanDevice® AX-3DS****: measurement range and the three axis are indicated on the Label*
5	Acceleration/inclination axis	Indicates acceleration/inclination on X/Y/Z axis
6	" ***Network*** " non-contact button	"**Network context**" non-contact button restores the factory settings on the BeanDevice®. Point the pole of the Neodymium magnet that was provided with your BeanDevice® towards the "Network" label circle. Hold the magnet for approximately ***2s*** ***Please read the following section for more information*** "click here"
7	"Network LED"	This bi-color **GREEN** / **RED Led** represents the BeanDevice® : Cf. table below for led description
8	ON/OFF Non- contact button	Allows to power up/power off the BeanDevice®. Point the pole of the Neodymium magnet that was provided with your BeanDevice towards the "ON/OFF" label circle (refer fig. 3) (**V1R2 only**).Hold the magnet for approximately 2s

9	Battery charge indicator LED	This bi-color **GREEN** / **RED Led** indicates battery charge status: Cf. table below for led description

7.7.2 Leds description

Operating status	Network LED	Battery Charge LED
The BeanDevice® is power down with no external power supply connected	LED OFF	LED OFF
The BeanDevice® is power off & external power supply is connected.		***Green*** Led ON : battery charged ***Red*** Led ON : battery not charged
The BeanDevice® is power on with wireless TX/RX activity	***Green*** Led: Wireless Network Activity ***Red*** Led : Wireless transmission failure	
The BeanDevice® is power on	Green led toggling	
The BeanDevice® is power off (was power on before)	RED LED ON during 2s	

7.7.3 BeanDevice® AX-3DS/AX-3D/HI-INC/INC - Mechanical drawing

The BeanDevice® AX-3DS/AX-3D/HI-INC/INC products use the same sensor housing.

Enclosure Features

Material	Aluminum
Protection	IP66
Dimensions	(L/l/h : 80x55x21 mm)
Weight	135g battery included

Figure 1: Mechanical drawing - Beandevice® AX-3D/HI-INC/INC

7.7.1 BeanDevice® AX-3D/HI-INC/INC Xrange - Mechanical drawing

The BeanDevice® AX-3D/HI-INC Xrange products use the same sensor housing.

Enclosure Features

Material	Aluminum
Protection	IP67
Dimensions	(L/l/h : 100x71x30 mm)
Weight	165g battery included

Table 1 : BeanDevice AX-3D/HI-INC/INC enclosure feature

7.7.2 Antenna diversity

Antenna diversity is a technique that maximizes the performance of an antenna system. It allows the radio to switch between two antennas that have very low correlation between their received signals. Typically, this is achieved by spacing two antennas around 0.25 wavelengths apart or by using two orthogonal polarizations. So, if a packet is transmitted and no acknowledgement is received, the radio system can switch to the other antenna for the retry, with a different probability of success.

The diagram below provides information on the radome antenna performance:

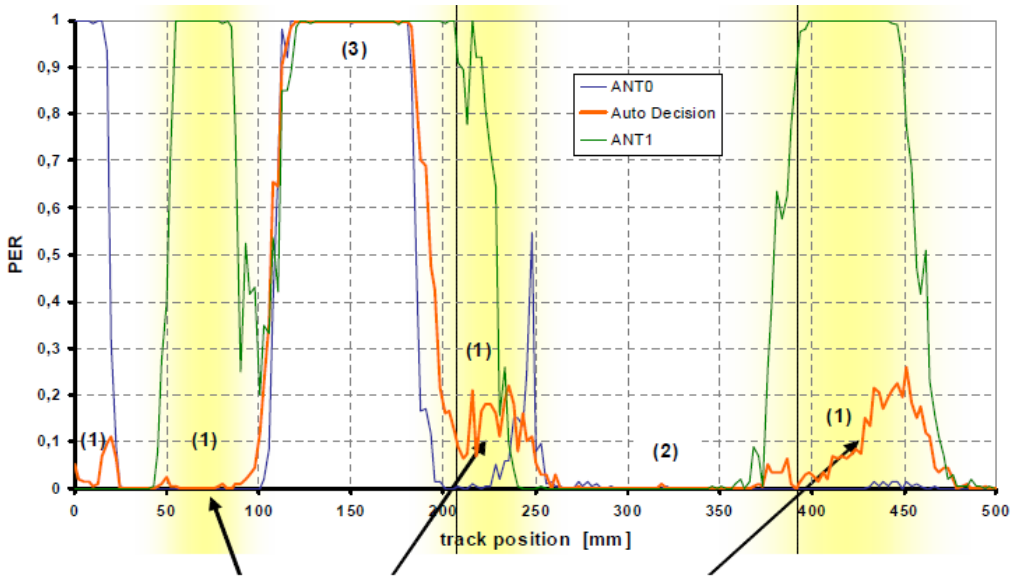
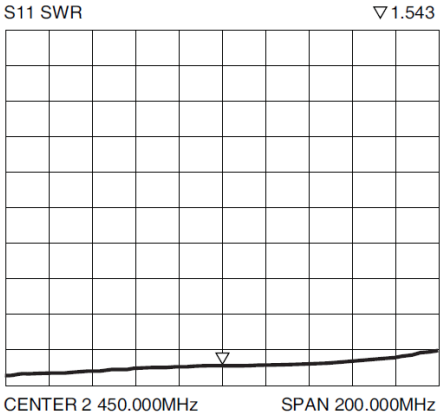


Figure 2 : Radome antenna performances

The radome antenna radio used on BeanDevice® product is a tamper resistant and unobtrusive.

7.7.3 Radome antenna

Electrical specifications	
Picture	
Center Frequency	*2,45 GHz*
Gain	*2,5 dBi*
Wavelength	*¼ -wave*
VSWR	*<1.9 typ. At center*
Impedance	*50 Ω*
Size	*Diameter: 27mm* *Height: 11 mm*



Typical VSWR

Figure 3: Antenna position on the BeanDevice AX-3D

Never try to change the antenna integrated on the BeanDevice®. This action may void the product warranty.

7.8 BEANDEVICE® AX-3D & AX-3D XRANGE: SENSOR CHARACTERISTICS

7.8.1 Sensor architecture

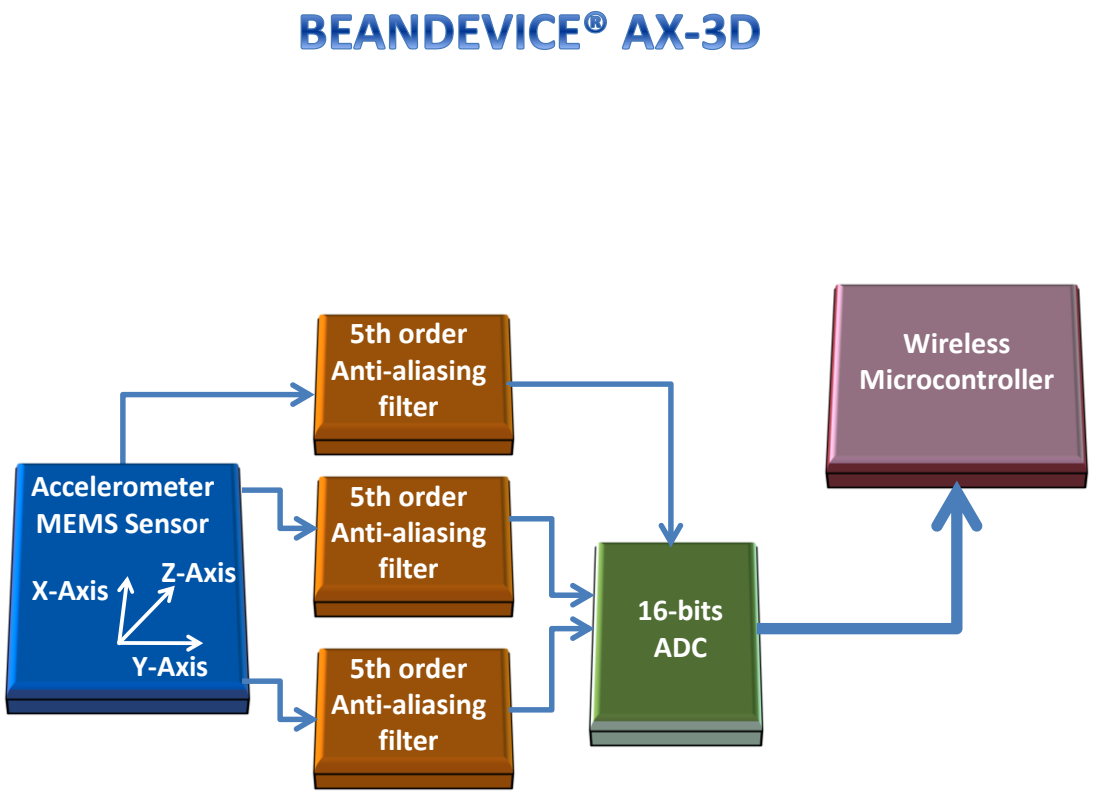


Figure 4: Sensor design

7.8.2 MEMS Accelerometer

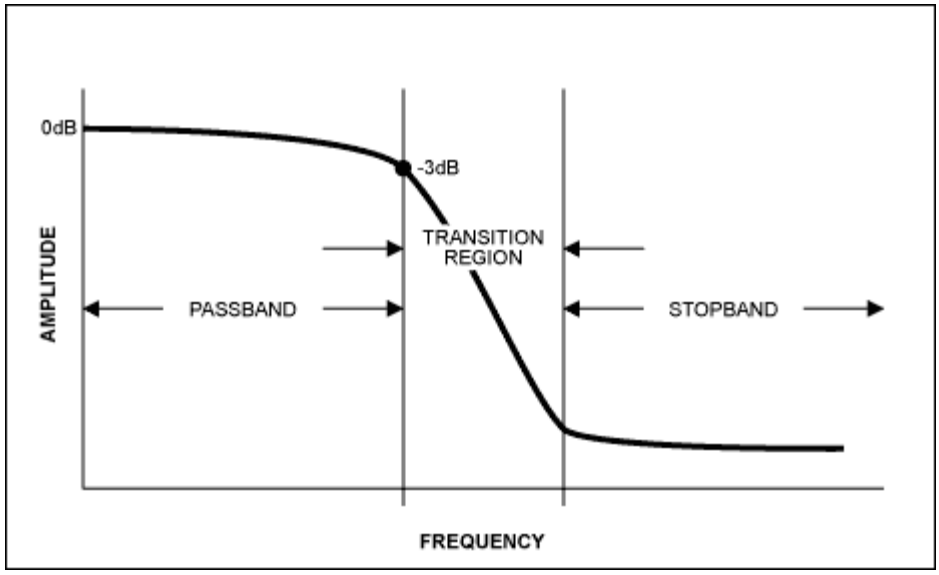
The BeanDevice® AX-3D integrates a tri-axis, silicon micromachined accelerometer with a full-scale output range of ±2g, ±10g.
Acceleration sensing is based on the principle of a differential capacitance arising from acceleration-induced motion of the sense element, which further utilizes common mode cancellation to decrease errors from process variation, temperature, and environmental stress. The sense element is hermetically sealed at the wafer level by bonding a second silicon lid wafer to the device using a glass frit.

7.8.3 5th order Anti-aliasing filter

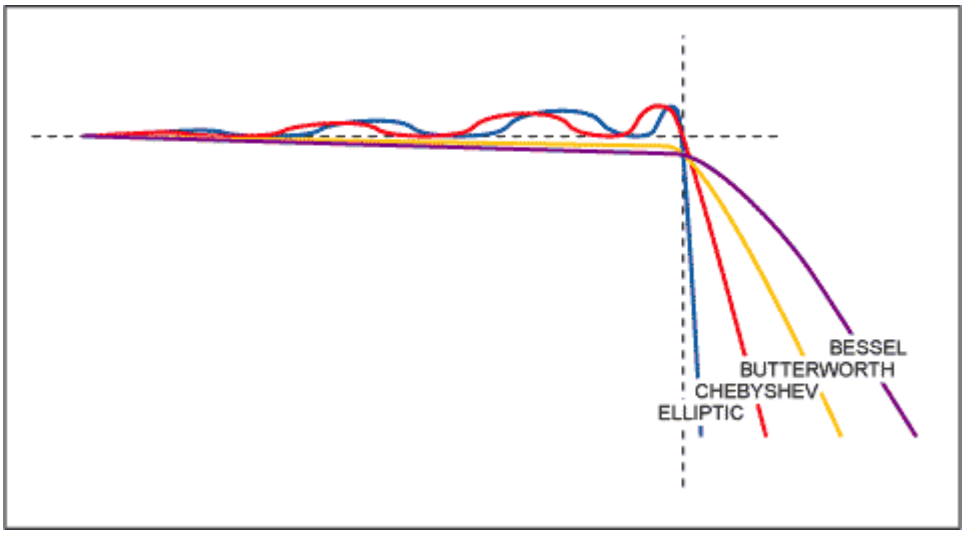
BeanDevice® AX-3D & HI-INC products integrates a high-performance 5th order Butterworth filter.

7.8.3.1 Why using an anti-aliasing filter ?

When selecting an analog filter, the goal is to provide a cutoff frequency that removes unwanted signals from the ADC input or at least attenuates them to the point that they will not adversely affect the circuit. An anti-aliasing filter is a low-pass filter that accomplishes this. How does one select the right filter? The key parameters that need observation are the amount of attenuation (or ripple) in the passband, the desired filter rolloff in the stopband, the steepness in the transition region and the phase relationship of the different frequencies as they pass through the filter.



Once the signal frequencies of interest are known, use a simple filter program to determine the filter topology needed to meet the passband, stopband, and transition region requirements. Of the four basic filter types, each has its own advantages

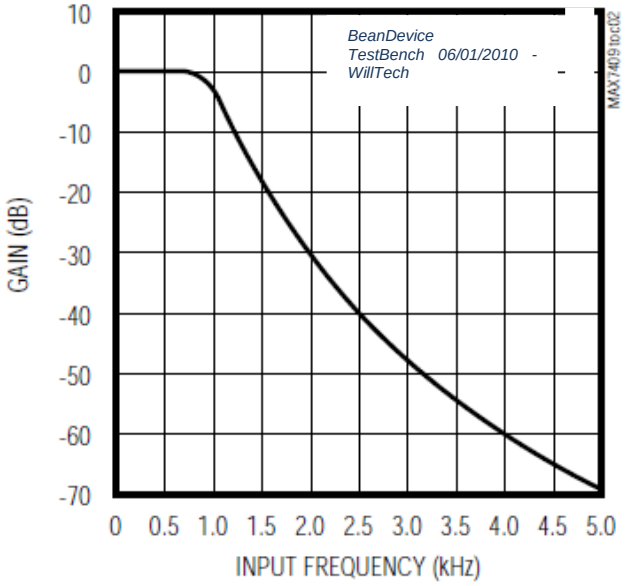


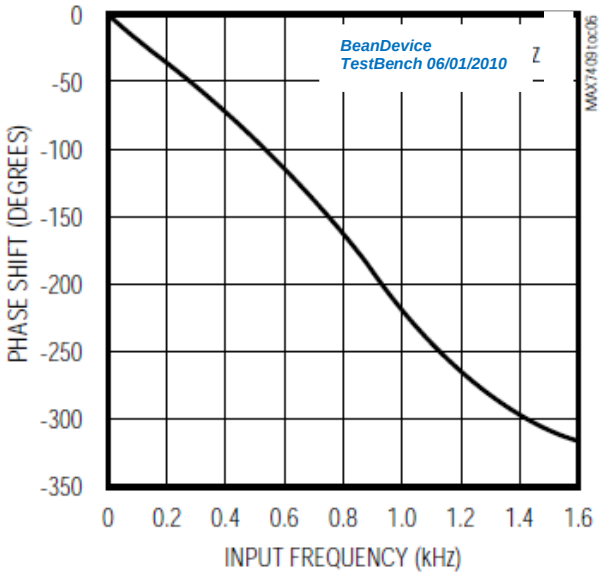
The Butterworth filter used on the BeanDevice® Smartsensor product lines, has the flattest passband region, meaning it has the least attenuation over the desired frequency range. The Bessel filter has a more gradual roll-off but its key advantage is that it has a linear phase response, meaning each frequency component is delayed by an equal amount of time as it passes through the filter. A linear phase response is often specified as a constant group delay, since group delay is defined as the derivative of the phase response with respect to frequency. The Chebyshev filter has a steeper rolloff but more ripple in the passband. The Elliptic filter has the steepest rolloff. For a simple anti-aliasing filter, often times a simple single-pole passive RC filter is acceptable. In other cases an active filter works well. One advantage of an active filter is that for multi-order filters, the operation of the filter is less sensitive to the values of the external components, in particular, the 'Q' value of the filter.

7.8.3.2 Anti-aliasing filter features

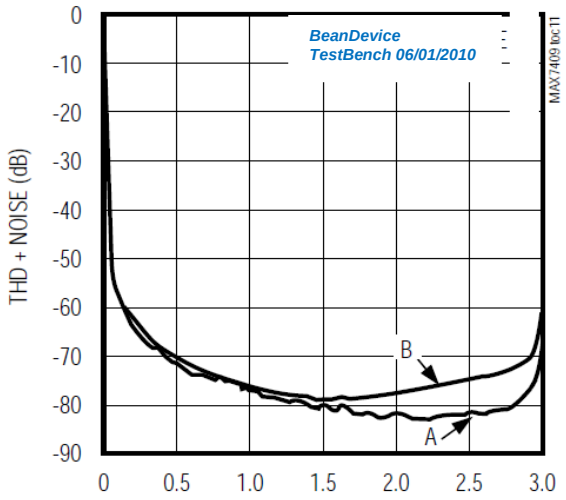
specifications	*Typical*
Type of Lowpass filter	*5-th Butterworth response*
Total harmonic distortion plus Noise (THD + N)	*-81 dB*
Typical Harmonic Distortion	*-86,4 dB*
Cutoff frequency (or corner frequency)	*Configurable from the BeanScape® :* *AX-3D : 0 à 2 KHz* *AX-HD : 0 à 2 KHz* *HI-INC : 0 à 60 Hz*

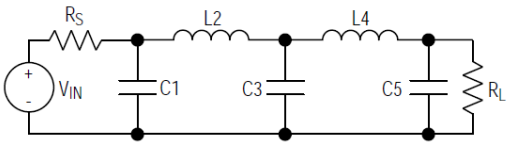
Frequency & Phase response curve cutoff frequency 1 KHz





Total Harmonic Distortion plus Noise vs Input signal amplitude





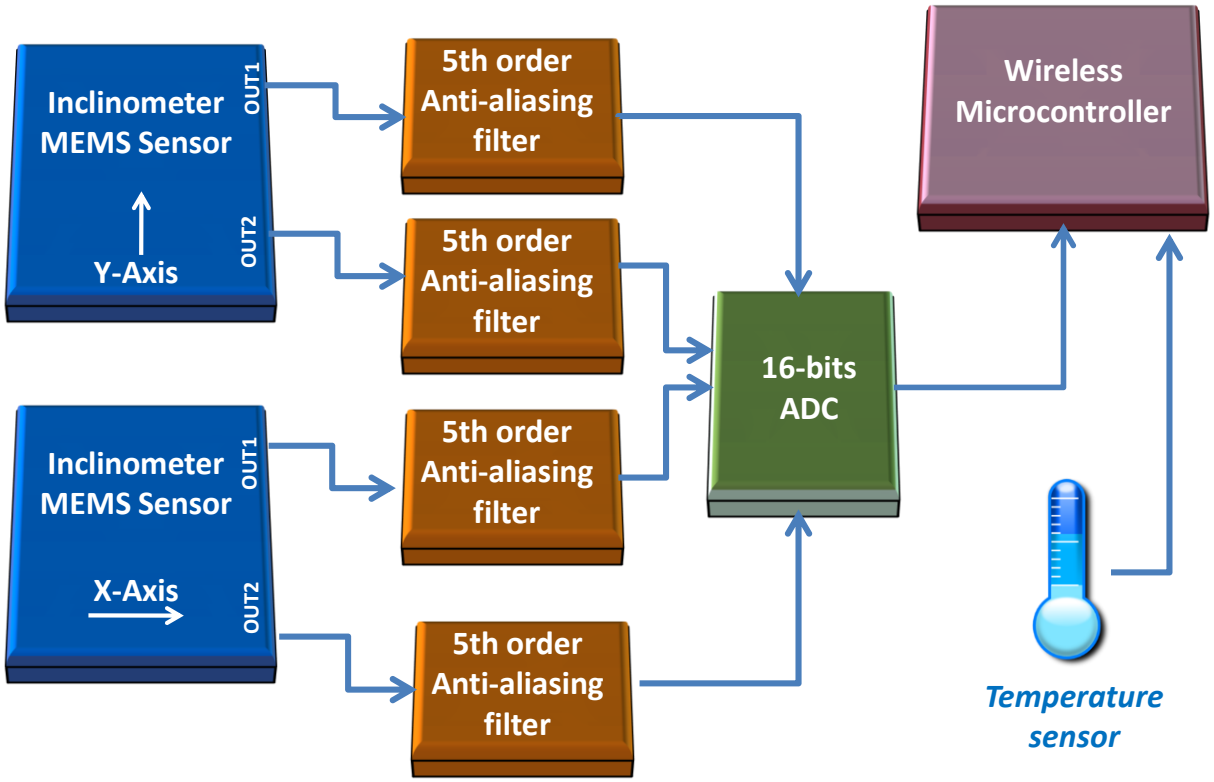
5th-order Ladder Filter network

7.8.1 Analog Digital Converter

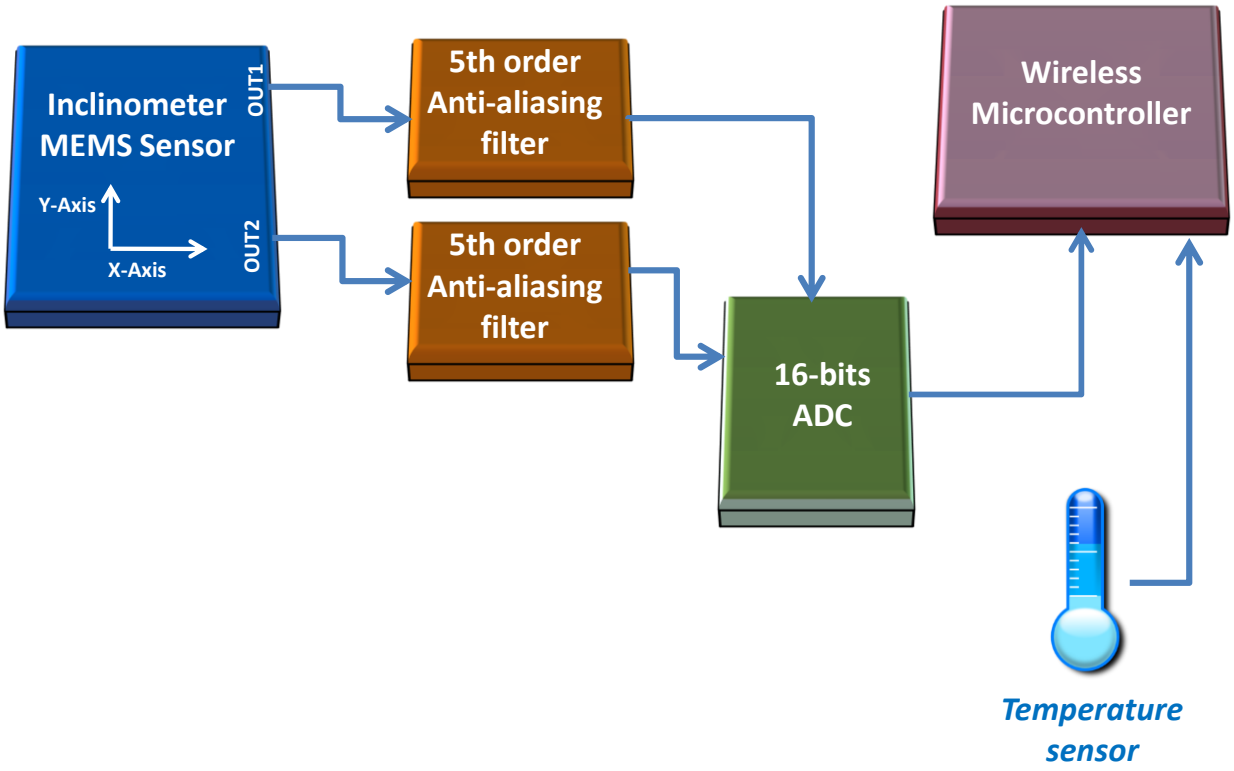
The Analog-to-Digital (16-bits) converter is based on a true SAR (Successive Approximation Register) architecture with no missing codes.
The ADC integrates an internal temperature sensor, which is useful for performing a system calibration.
The internal reference is temperature-compensated to within 10 mV. The reference is trimmed to provide a typical drift of ±10 ppm/°C.

7.9 BEANDEVICE® HI-INC & HI-INC XRANGE : SENSOR CHARACTERISTICS

7.9.1 Inclinometer Block Diagram (Beandevice® HI-INC ±30° and ±15° versions)



7.9.2 Inclinometer Block Diagram (Beandevice® version)



7.9.3 MEMS Inclinometer & differential output

The BeanDevice® HI-INC integrates a 3D-MEMS-based single axis inclinometer that uses the differential measurement principle. The high calibration accuracy combines extremely low temperature dependency, high resolution and low noise together with a robust sensing element design, to make the BeanDevice® HI-INC an ideal choice for high accuracy leveling instruments.

The inclinometer used on the BeanDevice® HI-INC ±15° and ±30° provides a differential output: the measuring axes of the sensing elements are mutually opposite in direction, thus providing two inclination signals which can be differentiated externally by our wireless processor.
The differential measurement principle removes all common mode measurement errors. Most of the error sources have similar effects on both sensing elements. These errors are removed from measurement result during signal differentiation. The differential measurement principle gives very efficient noise reduction, improved long term stability and extremely low temperature dependency.

7.9.4 5th order Anti-aliasing filter

Same specifications as BeanDevice® AX-3D

7.9.5 Analog to digital converter

Same specifications as BeanDevice® AX-3D

7.9.6 Accuracy considerations

Main error components are:

- ***Zero Point Error***

In most cases the most significant error component is the zero point error. In the range -25 … +85°C it is ±0.057° (6δ limit) and the temperature dependence is typically ±0.002°/°C. The room temperature variation can be reduced by calibration at the instrument level and the effects of the temperature dependence dealt with by using temperature compensation.

- ***Error Caused by the SIN Function:***

When used as an inclinometer, the output of the accelerometer is proportional to 1g * SIN (Phi + Phi0), where Phi is the inclination angle and Phi0 the internal mounting error. The internal mounting error is a maximum of ±2.9°, corresponding to ±50mg. This error is of importance when using large inclination angle amplitudes and is seen as an addendum to the non-linearity (Typically ±5mg in ±0.5g and ±10mg in ±1g).

- ***Cross-axis Sensitivity***

The cross-axis sensitivity (4%) shows how much perpendicular acceleration or inclination is coupled to the signal.

- ***Rectification of Vibration***

The effect of high frequency vibration is strongly suppressed by the over-damped sensing element (upper cut-off freq. f_{-3dB} = 0 … 10Hz). In an extreme case, high amplitude vibrations (>5g) may cause a measurable zero point shift.

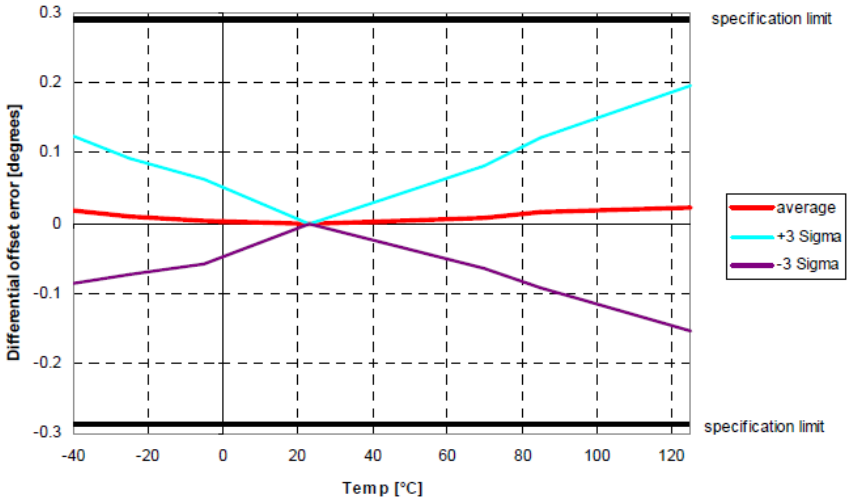
7.9.7 Offset & temperature dependencies

To achieve the best possible accuracy, an internal temperature sensor is used for sensitivity temperature dependency compensation. By using an additional 3rd order polynome compensation curve based on average sensitivity temperature dependency curve and temperature measurement information, it is possible to reduce sensitivity temperature dependency from:

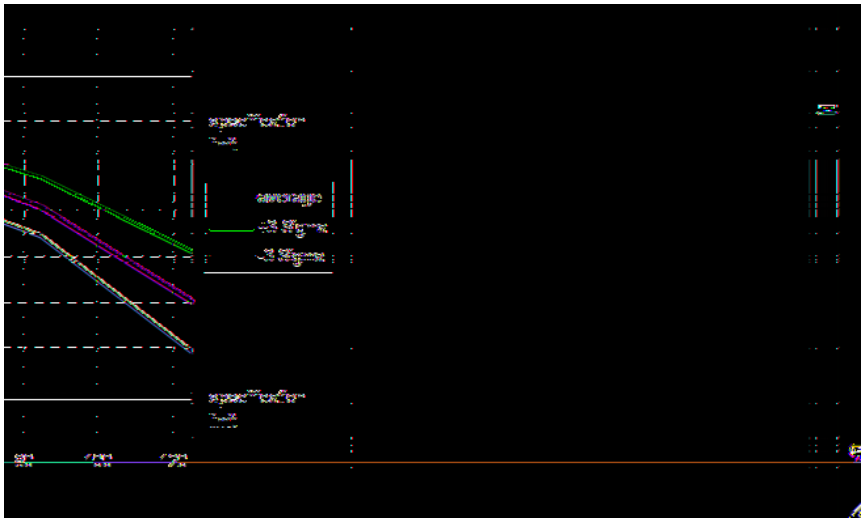
- ✓ 0.013%/°C down to 0.005%/°C for the BeanDevice® HI-INC ±15°and ±30° versions
- ✓ 0.014%/°C down to 0.008%/°C for the BeanDevice® HI-INC ±90°

Typical offset and sensitivity temperature dependencies of the inclinometer sensor are presented in following diagrams. These results represent the typical performance of inclinometer sensor components. The mean value and 3 sigma limit (mean ± 3× standard deviation) and specification limits are presented in following diagrams. The 3 sigma limits represents 99.73% of the inclinometer sensor population.

Temperature dependency of the inclinometer sensor offset (differential output)

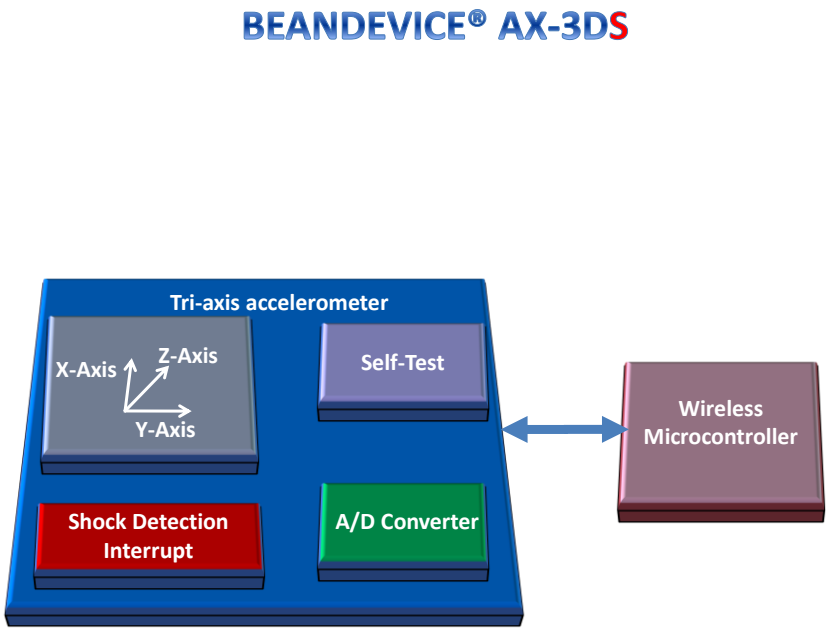


Temperature dependency of the sensor sensitivity [%] (differential output)



7.10 BEANDEVICE® AX-3DS: SENSOR CHARACTERISTICS

7.10.1 Mems Sensor architecture



7.10.2 Shock detection interrupt

The shock detection interrupt allows the Beandevice® AX-3DS to wake up when a threshold is reached. The threshold value can be modified from the BeanScape®.

This feature is used for "***Smart shock detection***" data acquisition mode.

7.10.3 Beandevice® current consumption in sleeping mode with SSD activated (Smart shock detection)

When SSD is activated, the BeanDevice will wake up if a shock is detected. During the sleeping mode of the BeanDevice®, the sensor will continu to track a shock event.

Depending on the sampling rate of the accelerometer during sleeping, the BeanDevice® current consumption can change:

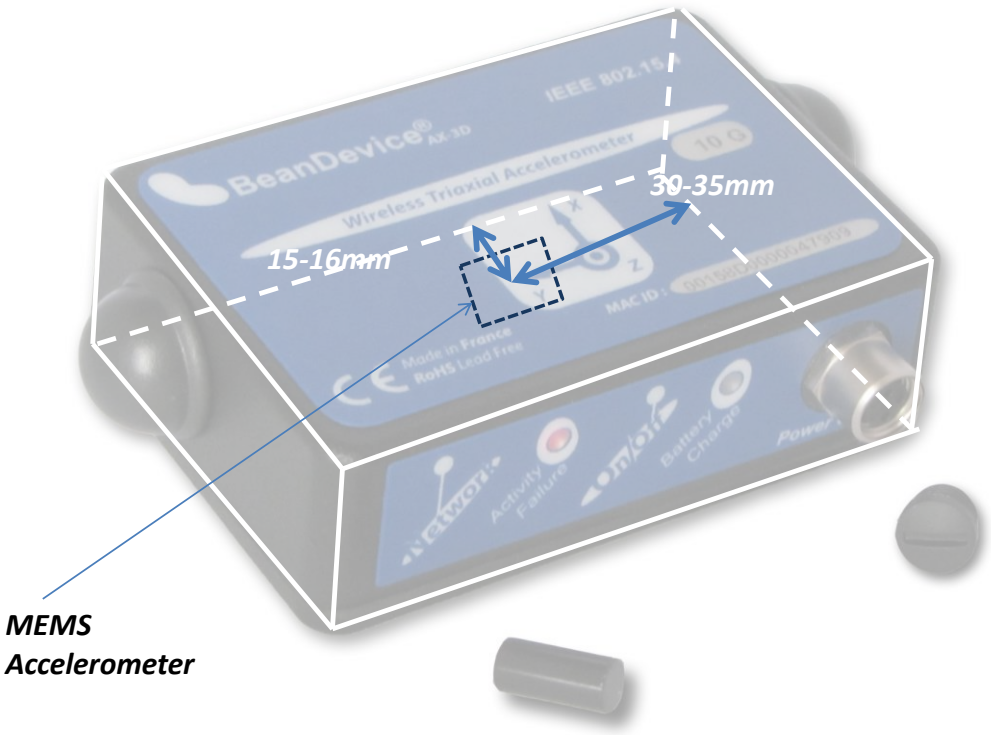
Accelerometer sampling rate during sleeping	*BeanDevice® AX3DS Current consumption*
0,5 Hz	*21 µA*
1 Hz	*31 µA*
2 Hz	*50 µA*
5 Hz	*78 µA*
10 Hz	*130 µA*
50 Hz	*302 µA*
100 Hz	*308 µA*
400 Hz	*343µA*
1000 Hz	*413 µA*

Table 2 : Beandevice® AX-3DS power consumptio for a given sampling rate

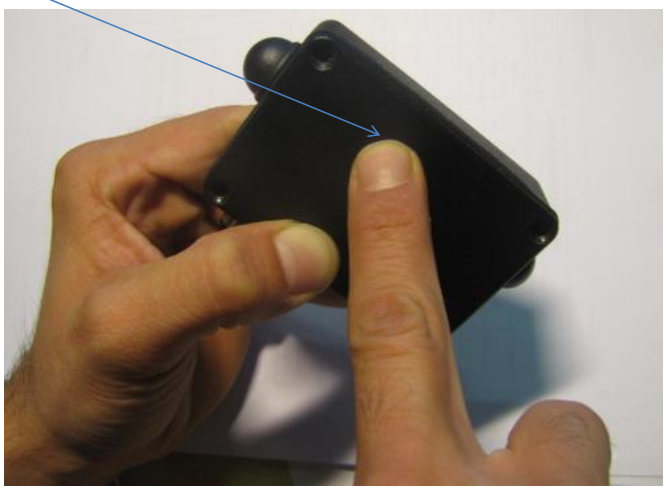
For further information about the SSD (Smart Shock Detection) measurement mode, read the technical note TN_RF_008 – "Data acquisition modes available on the BeanDevice®"

7.11 SENSOR POSITION INSIDE THE CASING

7.11.1 BeanDevice® AX-3D



Position of the MEMS Accelerometer



7.12 MOUNTING GUIDELINES

7.12.1 Adhesive mounting instructions (BeanDevice® INC, HI-INC, AX-3D, AX-3DS)

Characteristics	SmartSensor
Mounting techniques	Ashesive mounting
Flatness	0,1 mm
Surface Roughness	0,1 mm
Surface treatment	Satin black textured polyester powder paint
Material	AL 6061

7.12.1.1 Components needed for a non-permanent mounting

Aluminium Foil Tape	Use an aluminium foil offering a good breaking load & water resistant for outdoor use. ***Example***: Advance Tapes – Ref: 196074 - Thickness 0,09mm - Breaking load: 35 N/cm - Adhesion : 4 N/cm - Water resistant	
High strength Epoxy Glue	High Strength Epoxy Adhesive – Resin ***Example***: Radiospares 159-3957	

7.12.1.2 Reference edge

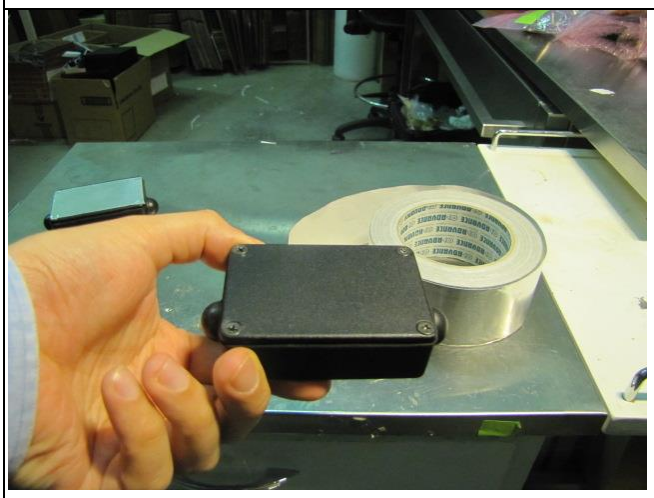
The Beandevice® has a mounting reference angle (red line) for an optimal mounting of the product, which is parallel to the Y-axis. This reference edge must be placed exactly parallel to the object to be measured to prevent or minimize any mechanical offset/cross sensitivity.

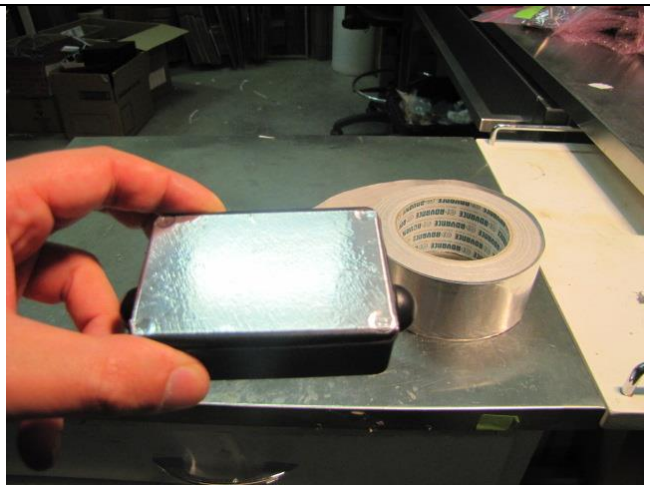
Reference edge, base plate side

7.12.1.3 Mounting instructions for non-permanent mounting

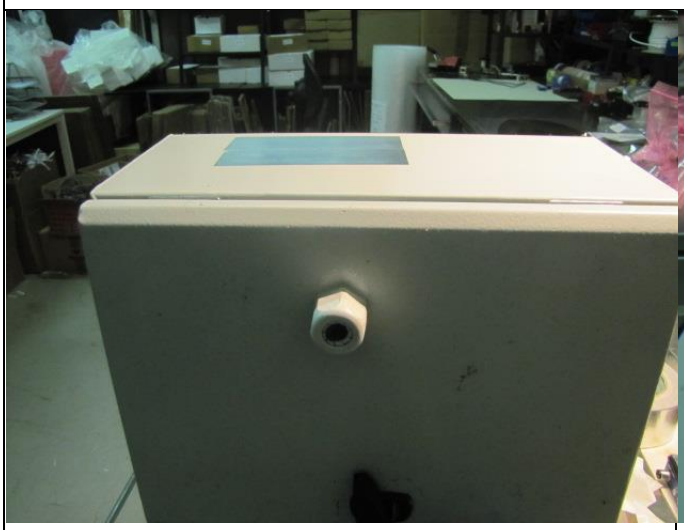
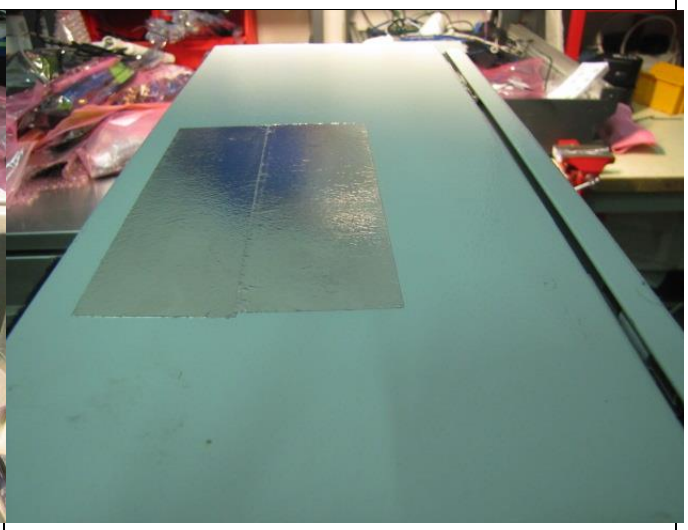
For a non-permanent mounting we recommend to use the following process:

Step 1: Fix the aluminum foil tape on the back side of your BeanDevice® casing. Surface should be clean, dry and free from Grease.

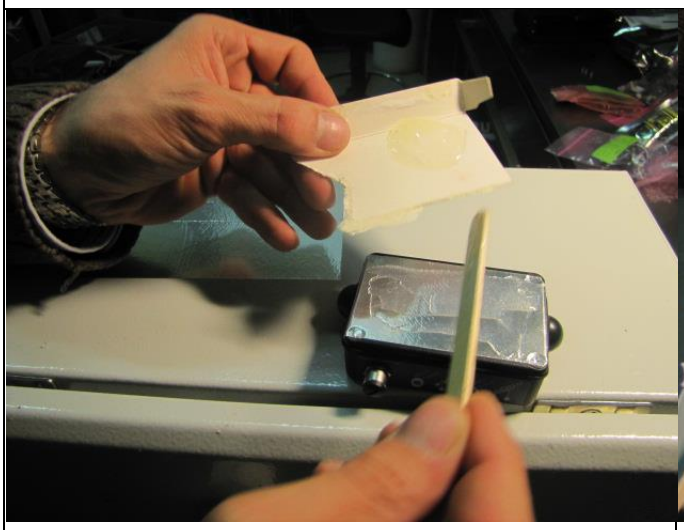
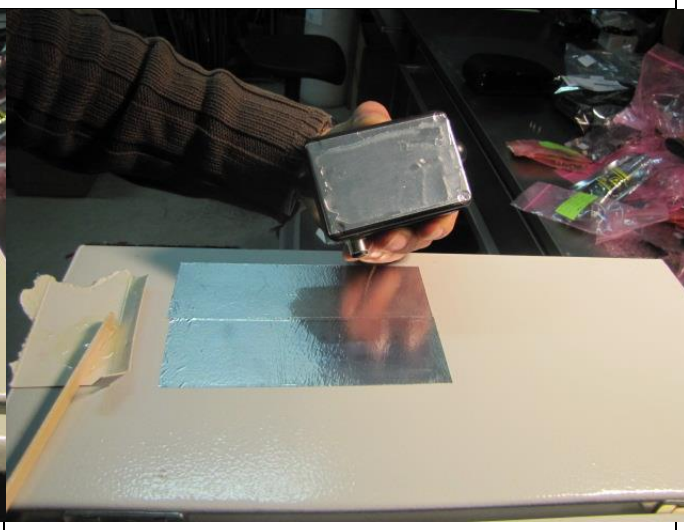




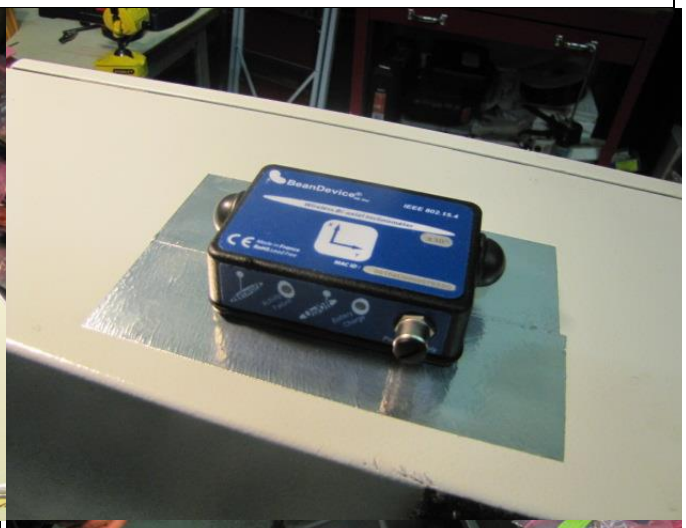
Step 2: Mount the aluminium foil tape on the equipment where you wanted to mount the BeanDevice®. Surface should be clean, dry and free from Grease.

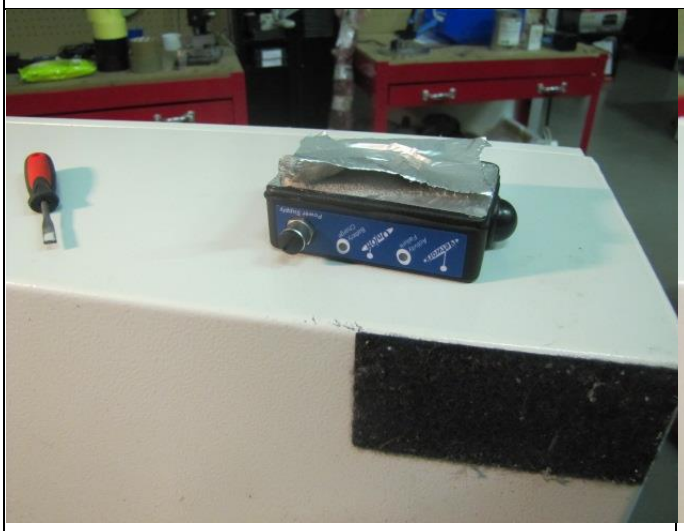
Step 3: Mix equal amount s of resin and hardener for 1 minute. Mixture should be used within 15-20 minutes. Apply the mixture on your BeanDevice®

Step 4: Clamp the two surface together until adhesive has cured (depending of the type of epoxy glue that you use, it can take 1 hour to 1 day). Your BeanDevice® is ready to be used for indoor and outdoor application.



Step 5: You can unmount the BeanDevice® very easily. Use a knife or a sharp object to unmount the Beandevice®. Your BeanDevice® is clean and ready to be used on another application.



7.12.2 Screw Mounting (Beandevice® AX-3D Xrange & Beandevice® HI-INC Xrange)

Characteristics	SmartSensor Xrange
Mounting techniques	**Screw mounting Three M5 drilled flanges**
Flatness	**38,1 µm**
Surface Roughness	**RA 1.6 (µm)**
Surface treatment	**Black anodized (Corrosionproof)**
Material	**AL 7075 (twice harder than AL6061)**

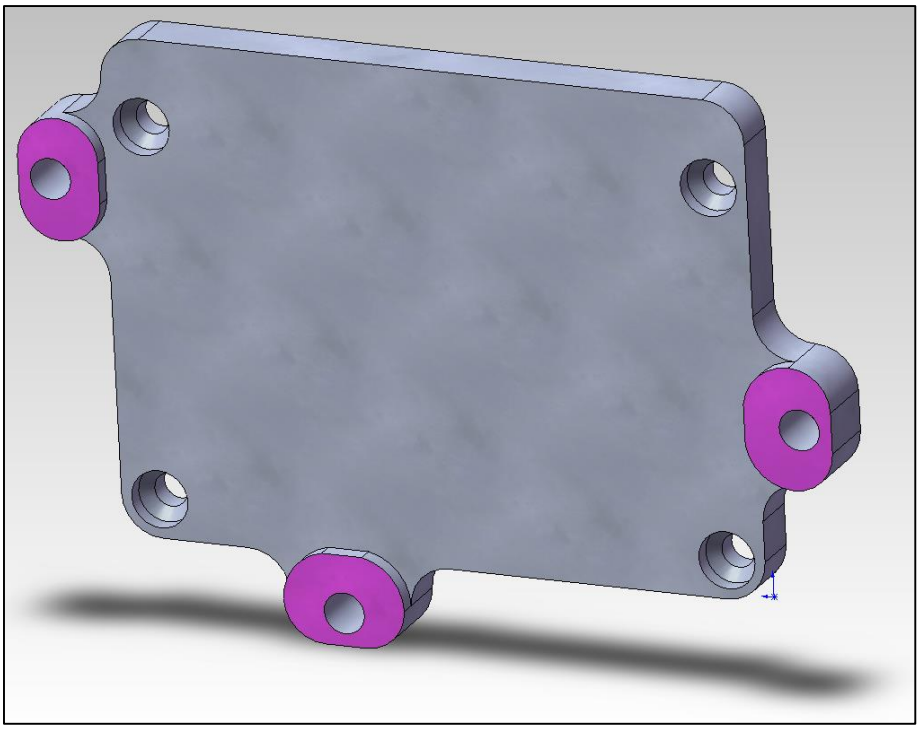


Figure 7-5 : Xrange base plate overview

- ✓ For vibration measurement, the mass of the wireless accelerometer must be <1/10 of the mass of the object under study.
- ✓ Mounting surfaces need to be clean, free of any residue from epoxies, waxes, paint or other foreign materials.
- ✓ Mounting surface should be flat.

- ✓ The mounting hole must be checked to ensure it is longer than the mounting screw so as to prevent "bottoming out".
- ✓ Use a torque wrench for tightening screws to the manufacturer's specifications. Do not use electric tools as their frequencies may damage the accelerometer.
- ✓ Spread mating surface with a light coating of silicone grease, heavy machine oil or bees wax to ensure contact issecure thereby maximizing the usable frequency range.
- ✓ Secure the cable using clamps, o-rings, tape or other materials most suited to the application. Ensure that you have sufficient slack to allow for free movement of the sensor.
- ✓ Inspect mounting holes and remove any debris, burrs or other foreign materials.

7.12.3 Wireless inclinometer special instructions (BeanDevice® HI-INC, INC & HI-INC Xrange)

The BeanDevice® HI-INC is designed for a horizontal mounting, i.e. the base plate of the inclinometer needs to be placed on the horizontal plane of the object to be measured.

Avoid shock and vibration during measurement, as these could corrupt the measurement results. Inclination sensors that base on a fluidic measurement principle are optimal for static measurements and suitable to only a limited extent of dynamic measurement.

7.13 BEANDEVICE® POWER SUPPLY

7.13.1 Integrated Lithium-ion Rechargeable battery

The BeanDevice® from Smartsensor product lines integrates a Lithium-Ion rechargeable battery:

BeanDevice® version	*Battery Capacity @25°C*	*Nominal Voltage @25°C*	*Charge/Discharge cycle @25°C*
Beandevice® AX-3D	1250 mAh	4,2V	370
BeanDevice® AX-3DS			
BeanDevice® HI-INC	950 mAh		

The rechargeable battery can be used as an UPS (uninterruptible power supply) battery on your BeanDevice®. It provides an emergency power when the external power source, typically the utility mains, fails.

Do not try to change the integrated battery. This action may void the product warranty.

7.13.2 External Primary cell (option)

The battery autonomy of the BeanDevice® can be increased by using an external primary cell with a capacity of 6500 mAh. The primary cell is integrated in a watertight (IP65) enclosure.

If external primary cell option is selected, the Beandevice® will be provided without an internal rechargeable battery.

7.13.2.1 Primary cell specifications

The Primary lithium-thionyl chloride cell (***Li-SoCl2***) provides the following features:

Primary Cell Capacity	*Size*	*Nominal Voltage*	*Operating temperature range*	*Maximum recommended continuous current*	*Pulse Capability*
6500 mAh	*C-size spiral cell*	*3,6 V*	*- 40°C/+ 85°C*	*1A*	*1.5 to 2A during 0.1s*

A Prirmary Cell is not a rechargeable battery; do not try to recharge it. You will damage your primary cell and your Beandevice®

We recommend you the following primary cell provider:

Provider	Model
SAFT	LSH14
Europa Batteries	ER26500M
EVE	
Able Battery	

7.13.2.2 Main advantages of primary cell

These are the main advantages of using a primary cell:

- ✓ The operating temperature of your Beandevice® is extended : -40°C to +85°C instead of -20°C to +75°C;
- ✓ The self-discharge of a primary cell is 2%/year instead of 12%/year for a rechargeable battery;
- ✓ The capacity of a primary cell is 6500 mAh instead of 1250 mAh,

Please read the following section for more information about the primary cell replacement and calibration: "click here"

7.13.3 AC-To-DC power adapter (option)

The BeanDevice® can also be powered by an AC-to-DC adapter ***8-28Volts***. The power adapter can be used for recharging Lithium-Ion battery or to power supply continuously the BeanDevice®.
A M8-3Pins standard plug is used for connecting the power adapter to the BeanDevice®.
If battery charge is very low, connect the power adapter in order to recharge your internal battery.

Only the M8 plug is fully sealed, the power adapter is not sealed.

7.13.4 External Power supply wiring code

Caption:

Pwr+ : Power supply 8-28V DC

Gnd : Ground

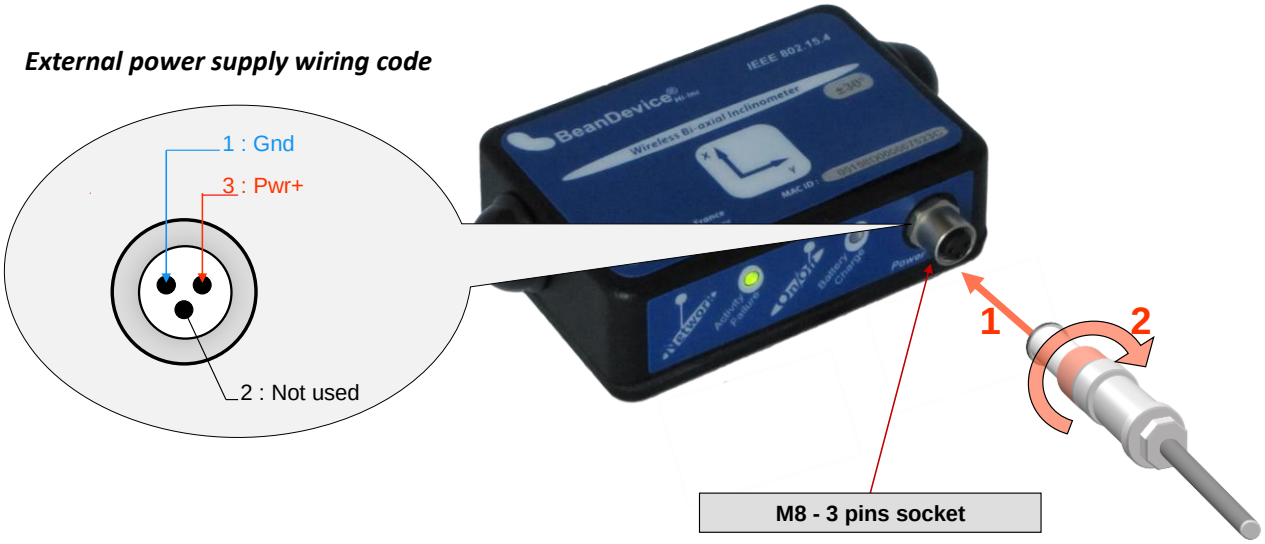
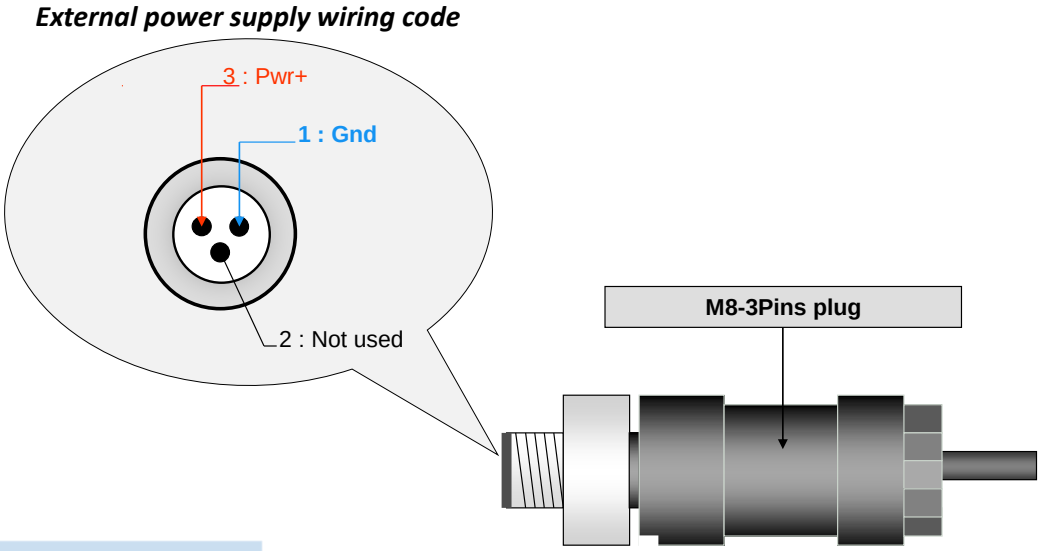


Figure 6: M8 socket Power supply wiring code (BeanDevice side)



Caption:

Pwr+ : Power supply 8-28V DC

Gnd : Ground

Figure 7: M8 plug - Power supply wiring code

8. SENSOR CALIBRATION

Depending on the operating temperature , it's highly recommend

BeanDevice® version		*Operating temperature < 40°C*	*Operating temperature > 40°C*
BeanDevice® AX-3D & Beandevice® AX-3D Xrange		**6 years**	**3 years**
BeanDevice AX-3DS		**4 years**	**2 years**
BeanDevice HI-INC, Beandevice® HI-INC Xrange and BeanDevice® INC		**6 years**	**3 years**

Go to this section for more information about sensor calibration

9. DATA ACQUISITION MODE DESCRIPTION

Please read the technical note TN_RF_008 – "Data acquisition modes available on the BeanDevice®"

10.BEANDEVICE® DEPLOYMENT GUIDELINE

10.1 POWER MODE MANAGEMENT

Please read the technical note TN_RF_010 – « BeanDevice® Power Management »

10.2 BEANDEVICE® NETWORK ASSOCIATION

Please read the technical note TN_RF_006 – "WSN Association process"

10.3 DATALOGGER FUNCTION

Please read the technical note TN_RF_007 – "BeanDevice® DataLogger User Guide "

10.4 OTAC (OVER-THE-AIR-CONFIGURATION) PROCESS

Please read the technical note TN_RF_010 – « BeanDevice® Power Management »

10.5 FACTORY SETTINGS

If desired, the user can perform a Network context deletion. It allows to restore default parameters on the BeanDevice® :

Parameter	*BeanDevice® version*		
	AX-3D	AX-3DS	HI-INC
Power Mode	*Active*	*Active*	*Active*
Data Acquisition duty cycle	*10s*	*10s*	*10s*
Acquisition duration time	*OK*	*OK*	*OK*
Sampling rate	*OK*	*OK*	*OK*
Data Acquisition mode	*LowDutyCycle*	*LowDutyCycle*	*LowDutyCycle*
TX Power	*+18dBm*	*+18dBm*	*+18dBm*
Alarms Threshold	*H1 :2, 10, 13* *H1 :2, 10, 13* *S2 : -2, -10, -13* *S1 : -2, -10, -13*	*H1 :20* *H2 :20* *S2 :0* *S1 :0*	*H1 :20* *H2 :20* *S2 :0* *S1 :0*
Anti-aliasing Filter cut-off frequency	*100 Hz*	*/*	*100 Hz*

To restore these defaults parameters, you must perform a ***Network context deletion***. The "**Network**" non-contact button is outside the product. Hold the magnet on the button network ("Network") for more than 2 seconds.

"Network" Reed non-contact button

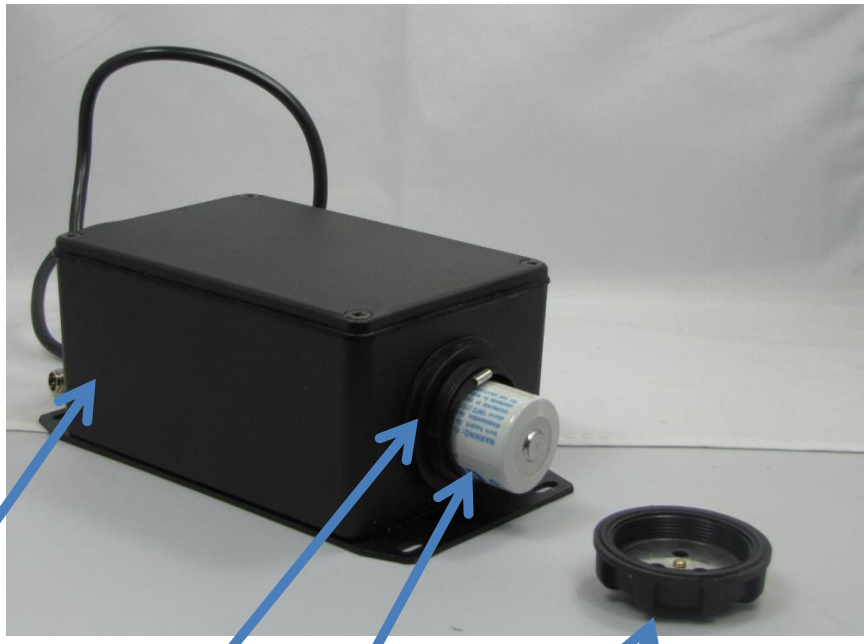
10.6 HOW TO CHANGE AND CALIBRATE THE PRIMARY CELL ON THE BEANDEVICE®

This section concerns the BeanDevice® provided with an external primary cell power supply.

All the BeanDevice® HI-INC/AX-3D/AX-3DS provided with an internal rechargeable battery are not concerned by this section.

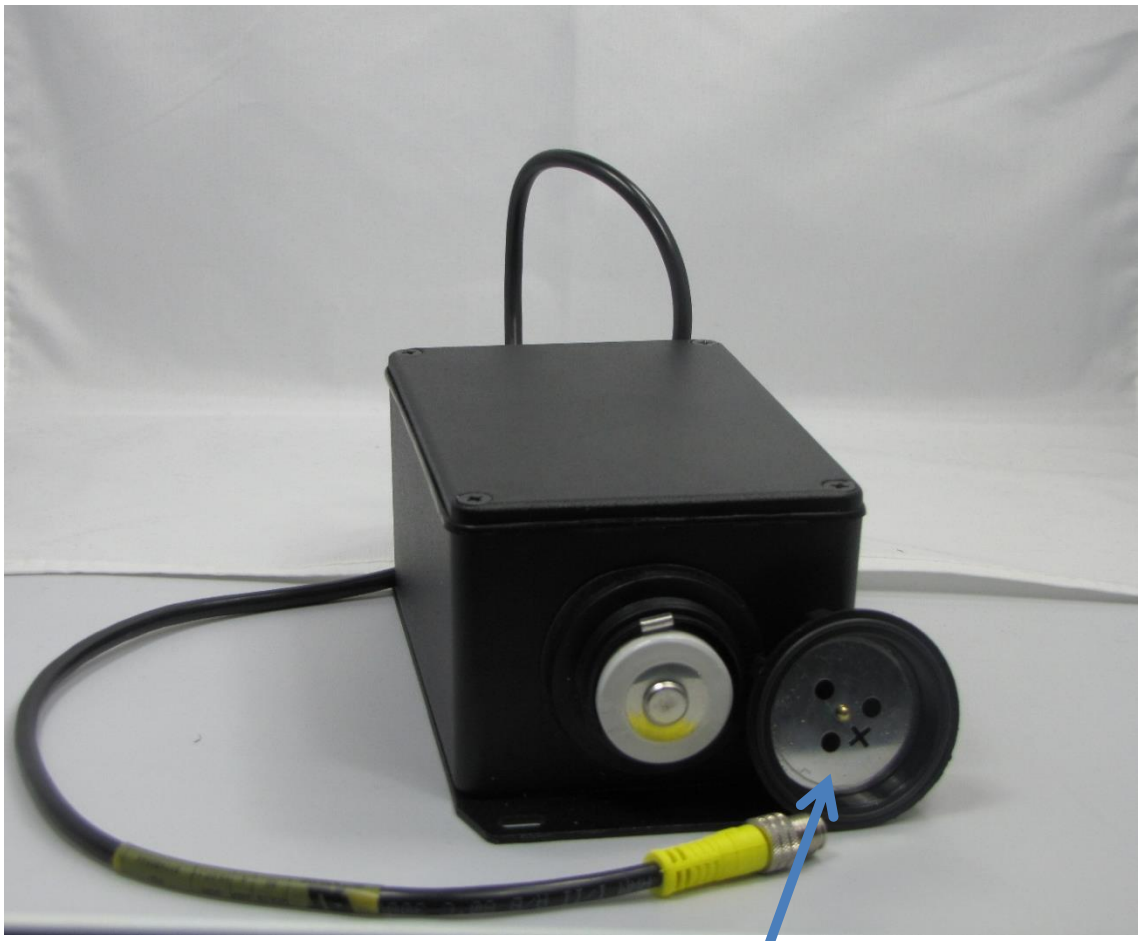
Step 1 : Open the screw cap

- Open the screw cap on the battery holder
- The primary cell (C Size) is inside the battery holder



Step 2 : Change the primary Cell

- Change the primary cell
- Check the battery polarity: pole + is on the screw cap side;



Step 3 : Close the screw cap

- Close properly the screw cap
- Don't forget the Gasket, it's very important to maintain a watertight seal on your device

Do not invert the battery polarity; your BeanDevice® will not work.

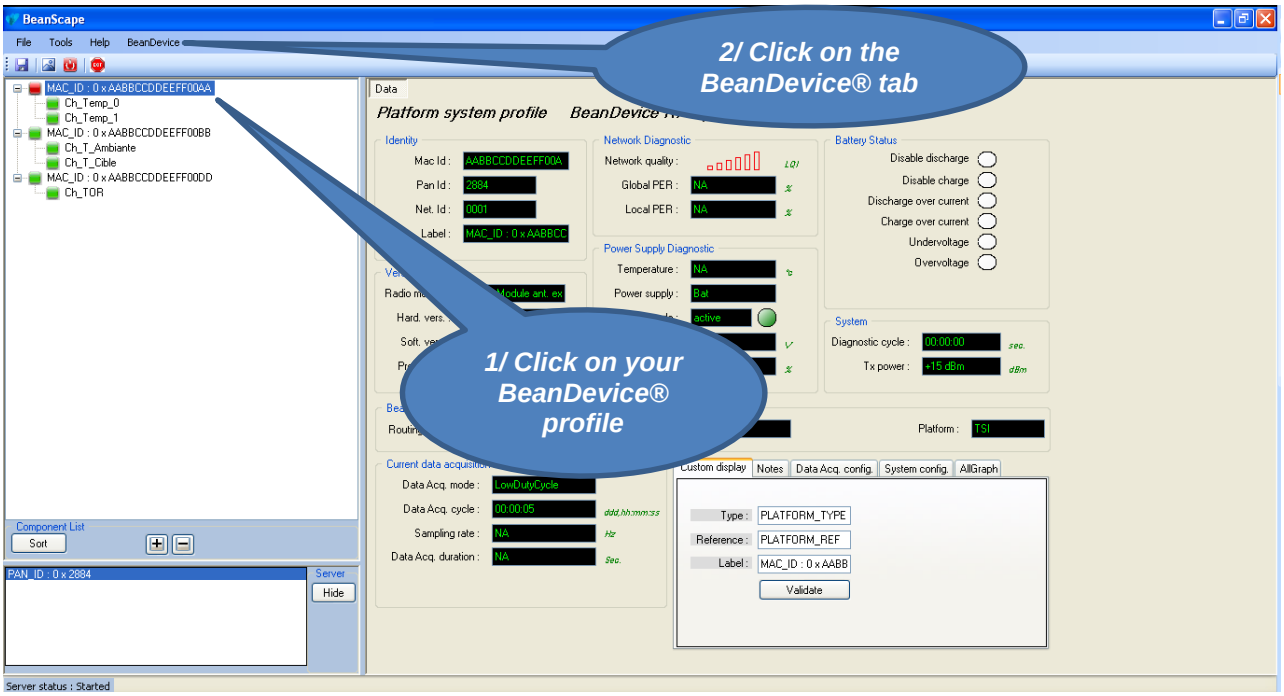
The primary cell is inverted

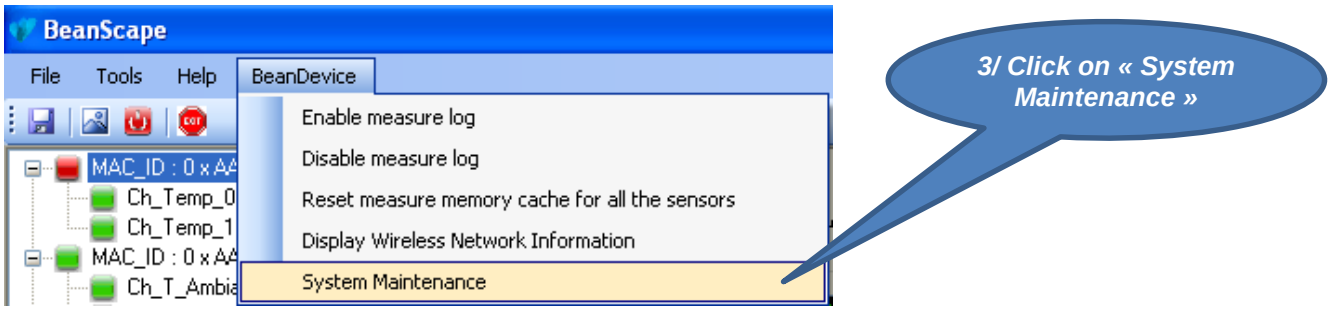
Step 4: Connect your primary cell enclosure to your BeanDevice®

- Screw the M8 Plug on the M8 socket of your BeanDevice®
- Make sure that your M8 plug is correctly connected to your M8 socket, otherwise the sealing between the enclosures is not maintained;

Step 5: Open the System maintenance window on your BeanScape®

- Launch your BeanScape® software application ;
- Select your BeanDevice® profile, a new tab "BeanDevice®" will appear on your BeanScape® toolbar;
- Click on this tab, and then click on "***System Maintenance***"

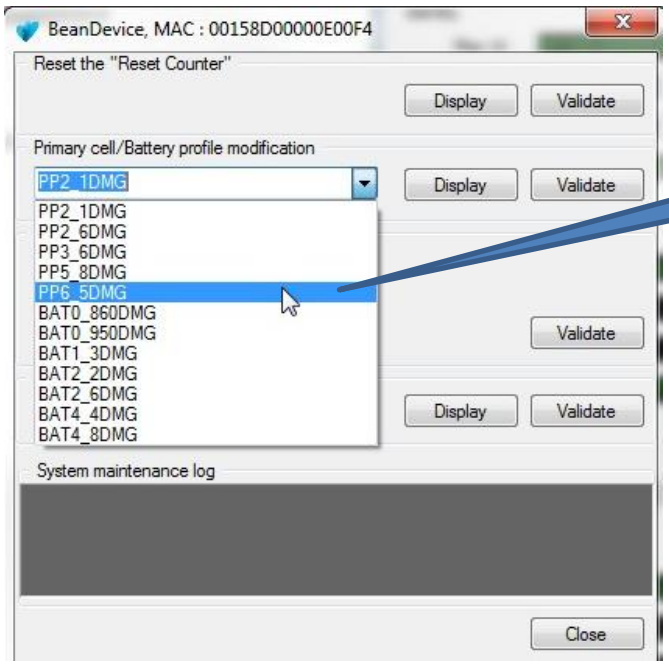


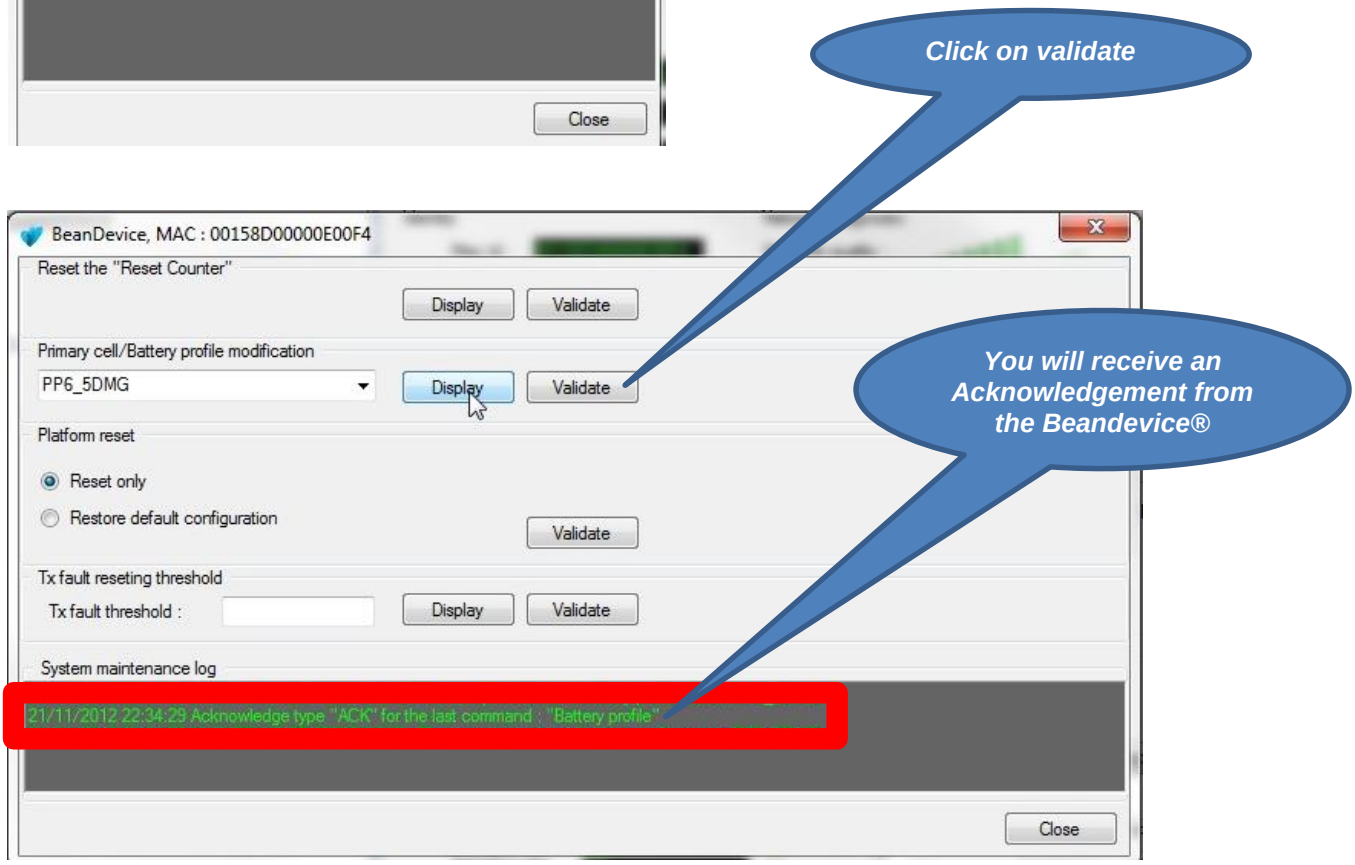


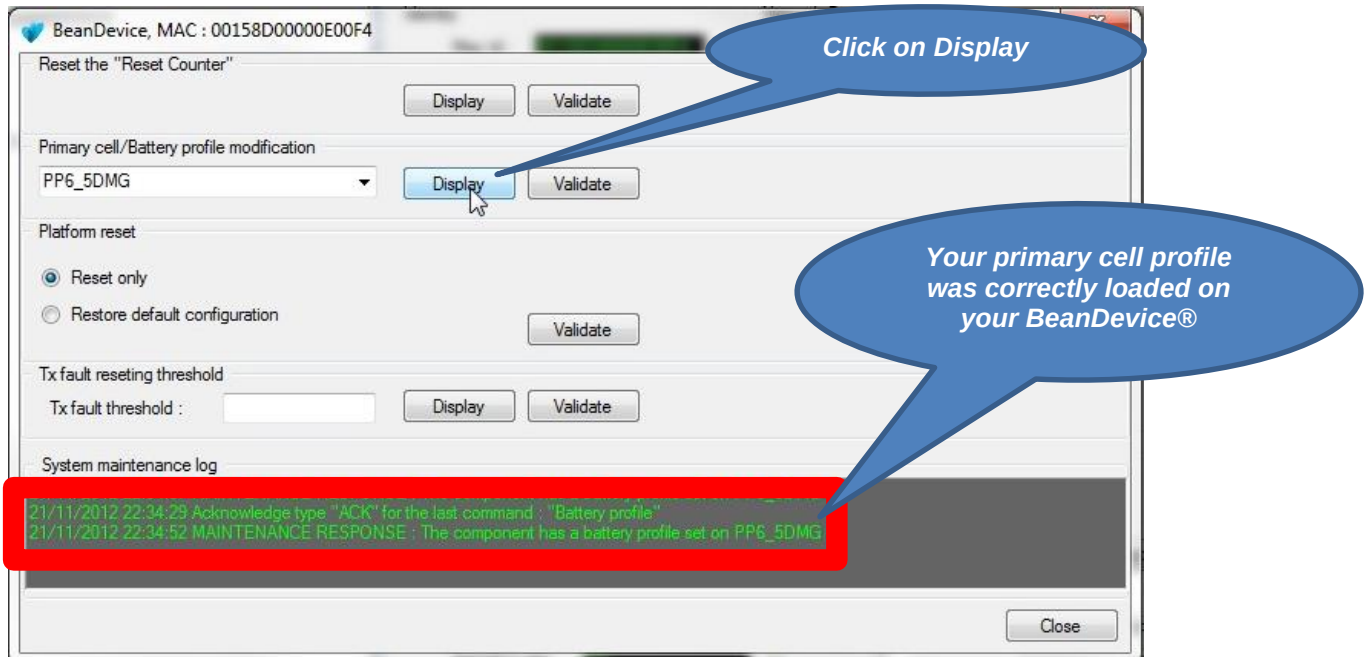
Step 6: Calibrate your primary cell from the BeanScape®

- Select the label ***PP6_5DMG*** in your scroll list. This label corresponds to a battery capacity of 6500 mAh.
- Click on "***Validate***"
- Wait for an Acknoledgment from the BeanDevice®
- To be sure that your Beandevice® is calibrated with the right capacity value, click on "***Display***"

Make sure that your primary cell is a new one. Don't try to re-calibrate a primary cell which was already used, a false battery level will be displayed.







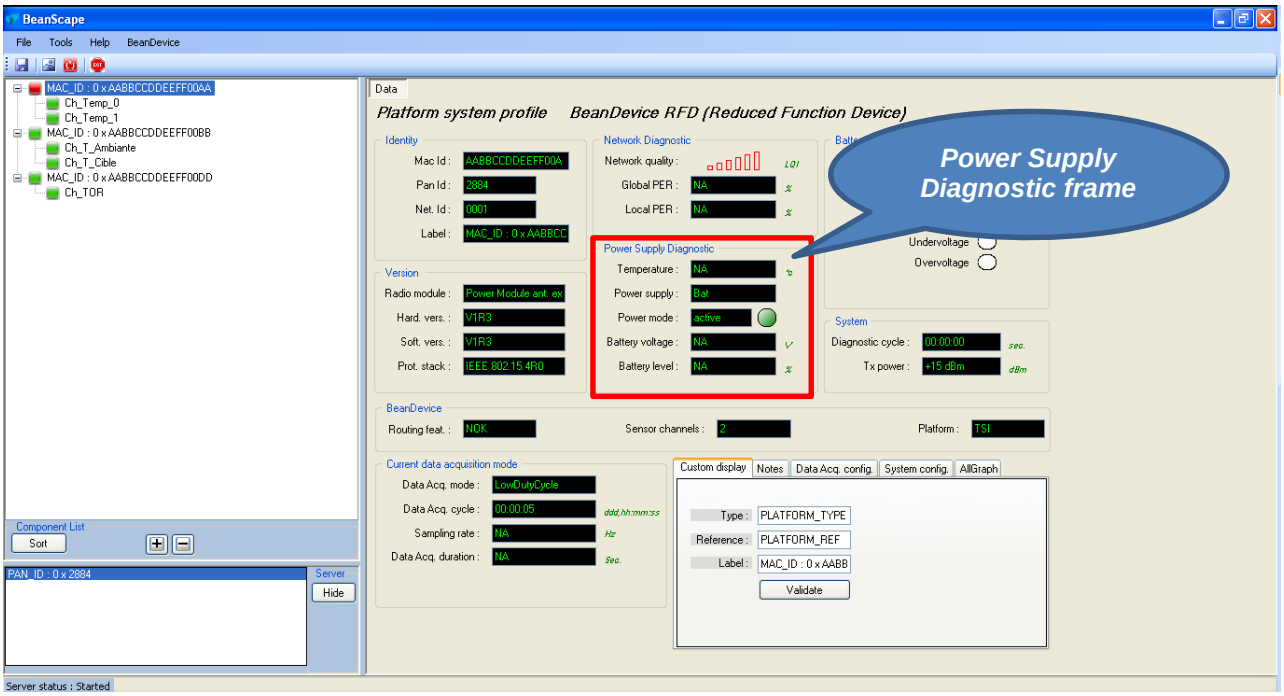
Check the Power mode of you Beandevice® before trying to configure your Beandevice®.

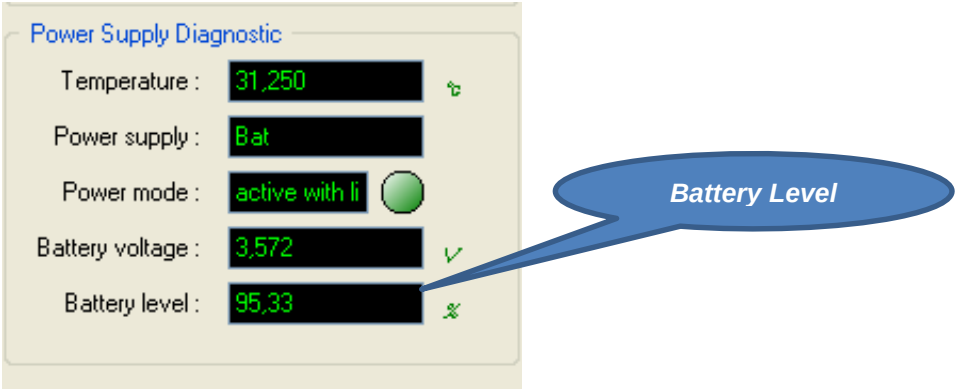
***Example:** If your BeanDevice® is operating in "Sleeping" power mode. You should Power off then power on your Beandevice®, the new configuration parameter is loaded during the coldstart of your BeanDevice®.*

*For further information about Power mode management, please read the technical note **TN_RF_010 – « BeanDevice® Power Management »***

Step 7: Check your battery charge level

- Check the battery charge level which is dsplayed in the "***Power Supply Diagnostic frame***" , battery charge level should be 100%





The nominal voltage of a primary cell is 3,6 Volts instead of 4,2 volts for a rechargeable battery. This value is correct.

Make sure that the power mode configured on your Beandevice® is in "sleep" or "sleep with network listening". If the power mode is configured in active, the battery autonomy of your Beandevice® will be dramatically reduced.

11. BEANDEVICE® SUPERVISION FROM THE BEANSCAPE®

For more information about the BeanScape®, please read the BeanScape® User Manual.

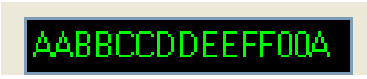
11.1 STARTING THE BEANSCAPE®

The BeanScape® is a supervision software monitor fully dedicated to BeanAir WSN (Wireless Sensor Networks):

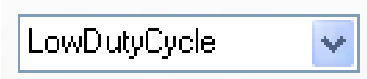
1. *Start the BeanScape® by double-clicking on the BeanScape® icon*
2. *Click on the button « start »*
3. *All the BeanDevice® connected to the WSN will appear on your left window*
4. *Select the BeanDevice® you want to configure. You can configure your BeanDevice® and its attached sensors.*

The user interface is organized as follow:

- Green on black background are displaying information

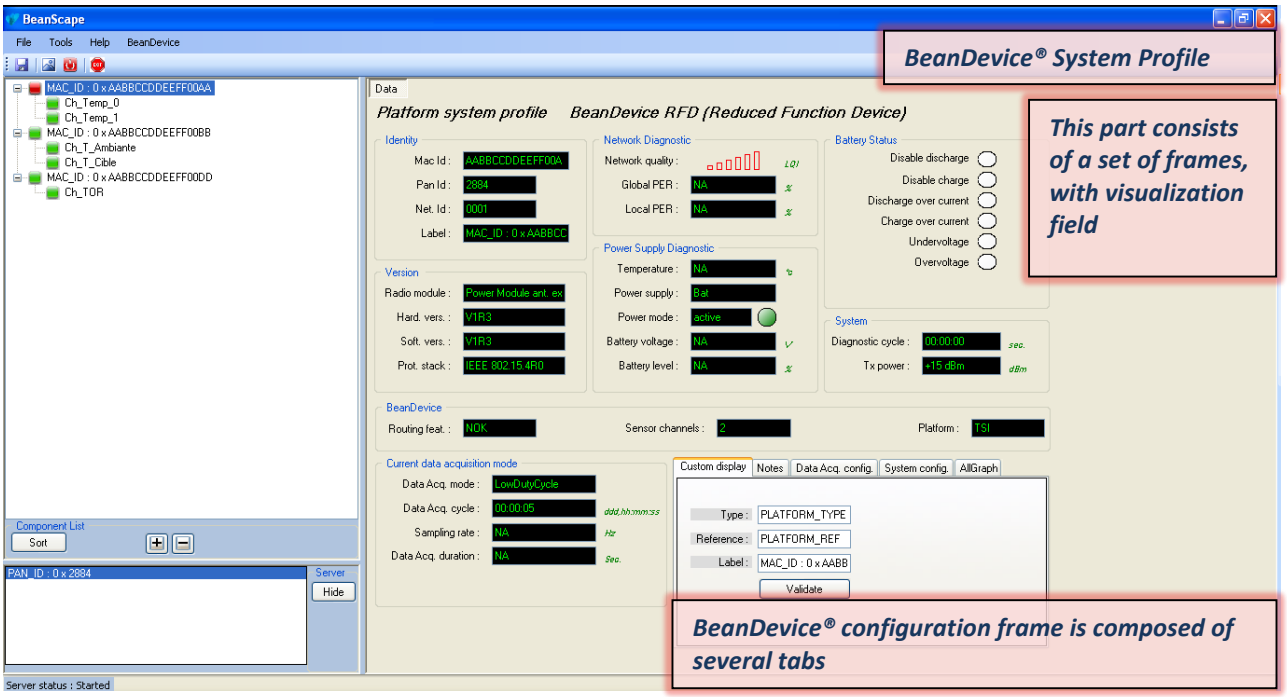


- Black on white background are customizable field;



You can configure your BeanDevice® from the page "***BeanDevice® System Profile***". This page is composed of two parts:

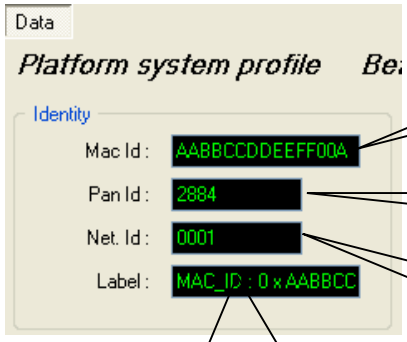
- ✓ BeanDevice® information display;
- ✓ BeanDevice® configuration;



11.2 DISPLAYING THE BEANDEVICE® INFORMATIONS

You will find below a description of the data information fields making up for each frame.

11.2.1 Frame: Identity



MAC Address (encoded on 64-bits): The Media Access Control address is an unique identifier assigned to the BeanDevice® by the manufacturer for identification.

PAN Address (encoded on 16-bits): Personal Area Network address.

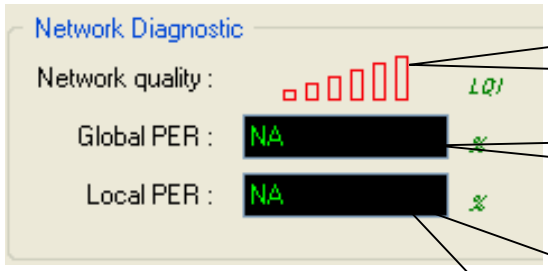
Network Address on 16-bits: This address is allocated by the BeanGateway® when you start the network.

BeanDevice® Label: By default the MAC address is registered as a Label. This label can be changed by the user.

How the PAN ID is assigned ?

The BeanGateway® starts the WSN, assigning a PAN ID (Personal Area Network identifier) to the network. The PAN ID is pre-determined and cannot be modified. If you use several WSN, before deploying your BeanDevice® check to which WSN is assigned your BeanDevice®.

11.2.2 Frame : Wireless Network Diagnostic



Link quality indicator of the BeanDevice® (0 to 255)

255=> Excellent

0 => bad

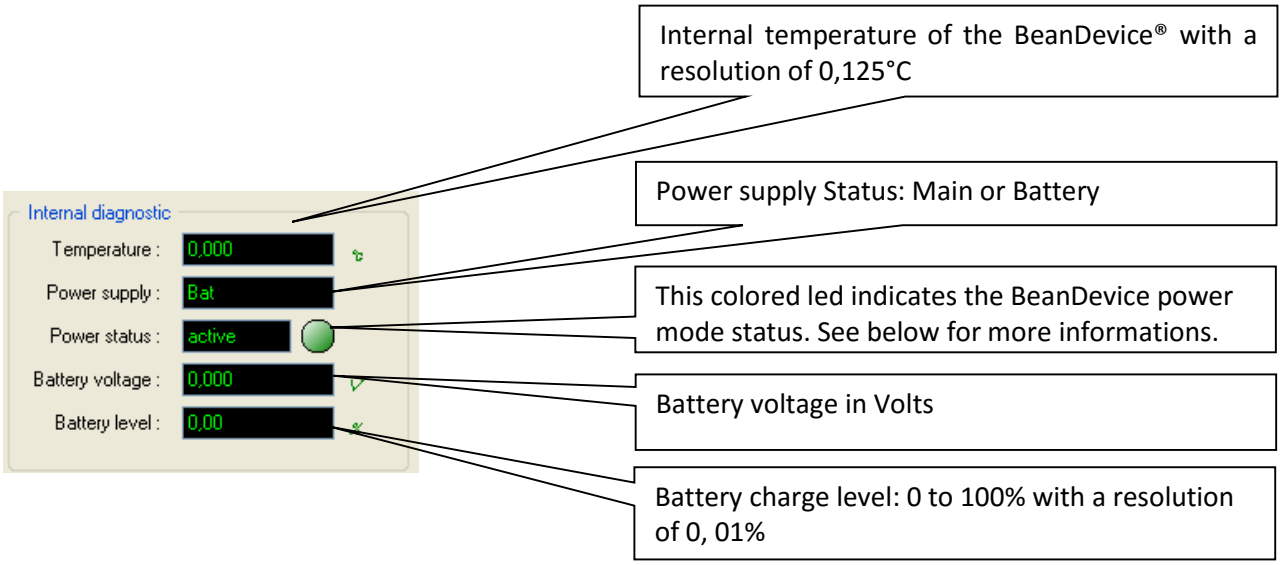
Global Packet error rate (PER): represents the PER on a wireless path. ***Not available on IEEE 802.15.4 network.***

Local Packet error rate (PER): represents the PER between parent and child nodes.

PER = Number of lost packet/Total of packet transmitted

Number of bars	Color	Link quality indicator
5 to 6 bars	Green	Very good
4 bars	Green	Good
3 bars	Orange	medium
1 to 2 bars	Red	bad

11.2.3 Frame : Internal diagnostic


Internal temperature of the BeanDevice® with a resolution of 0,125°C
Power supply Status: Main or Battery
This colored led indicates the BeanDevice power mode status. See below for more informations.
Battery voltage in Volts
Battery charge level: 0 to 100% with a resolution of 0, 01%
Internal diagnostic
Temperature : 0,000
Power supply : Bat
Power status : active
Battery voltage : 0,000
Battery level : 0,00

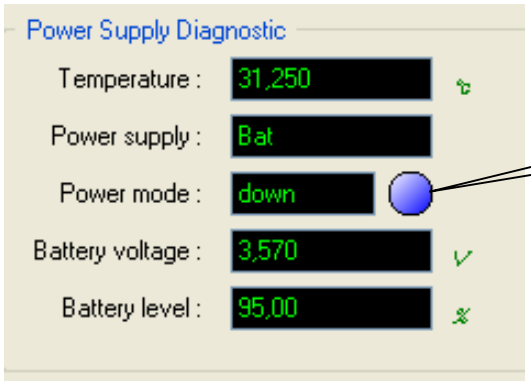
The BeanDevice® incorporates an internal temperature sensor dedicated to the following tasks:

- ✓ ***Battery temperature monitoring during charging ;***
- ✓ ***Temperature compensation of the analog conditioning chain ;***
- ✓ ***An alarm notification is send to the BeanGaeway® if the internal temperature is anormally high ;***

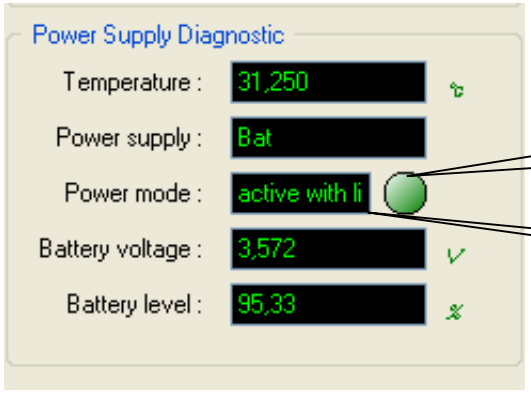
When you plug the BeanDevice® on an external power supply, the power supply status is automatically detected.

If your primary cell charge level is under 5%, it is highly recommended to recharge your battery. Your BeanDevice® from SmartSensor product lines integrates a battery charger.

For further information about Power mode management, please read the technical note TN_RF_010 – « BeanDevice® Power Management »

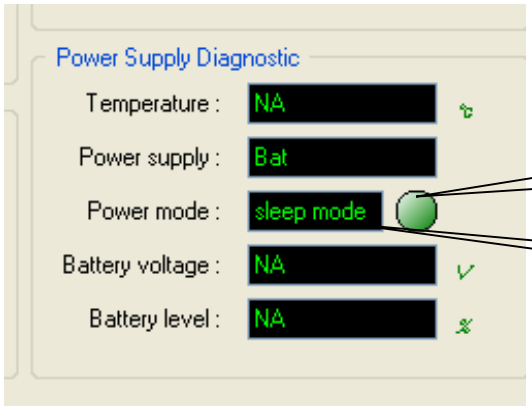


BLUE LED: The BeanDevice® is power off


Power Supply Diagnostic
Temperature : 31,250
Power supply : Bat
Power mode : active with li
Battery voltage : 3,572
Battery level : 95,33

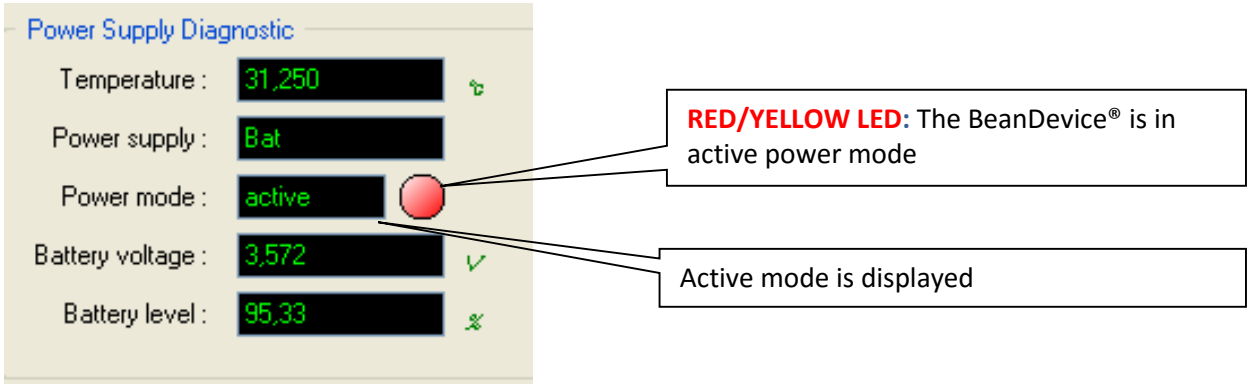
GREEN LED: The BeanDevice® is in sleeping with network Listening power mode

Sleeping with network listening power mode is displayed

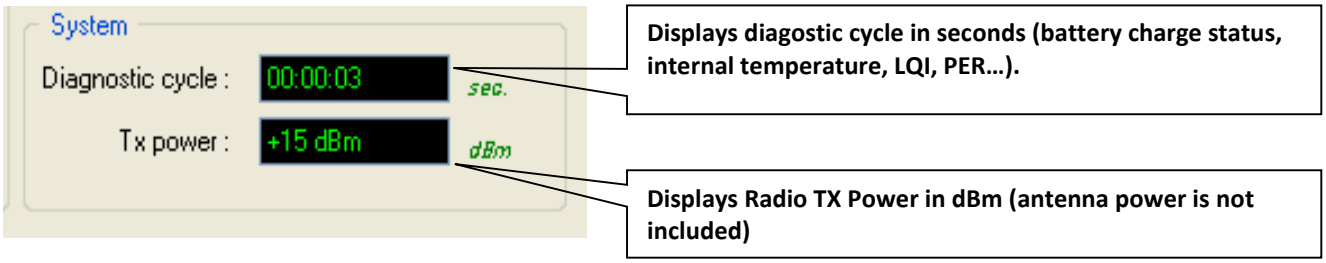


GREEN LED: The BeanDevice® is in active sleeping power mode

Sleeping power mode is displayed

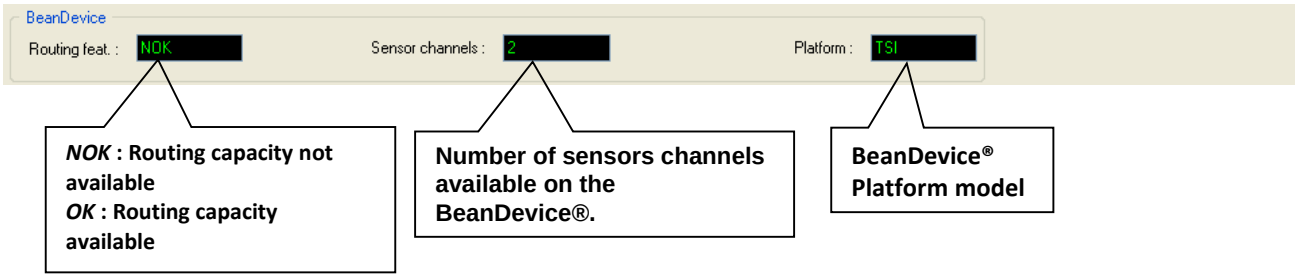

Power Supply Diagnostic
Temperature : 31,250
Power supply : Bat
Power mode : active
Battery voltage : 3,572 V
Battery level : 95,33 %
RED/YELLOW LED: The BeanDevice® is in active power mode
Active mode is displayed

11.2.4 Frame : System


System
Diagnostic cycle : 00:00:03 sec.
Tx power : +15 dBm dBm
Displays diagostic cycle in seconds (battery charge status, internal temperature, LQI, PER…).
Displays Radio TX Power in dBm (antenna power is not included)

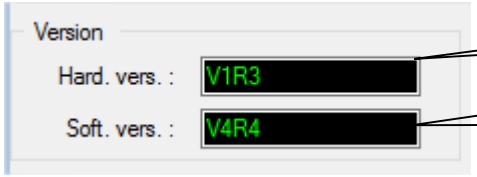
11.2.5 Frame : BeanDevice®

According to the BeanDevice® version, the information displayed in the frame will not be the same. For example, for the BeanDevice® TSI:


BeanDevice
Routing feat. : NOK
Sensor channels : 2
Platform : TSI
NOK : Routing capacity not available
OK : Routing capacity available
Number of sensors channels available on the BeanDevice®.
BeanDevice® Platform model

Routing capacity is not available on IEEE 802.15.4 protocol stack

11.2.6 Frame : Product Version



Hardware version: BeanDevice® hardware

Software version: BeanDevice® embedded software version

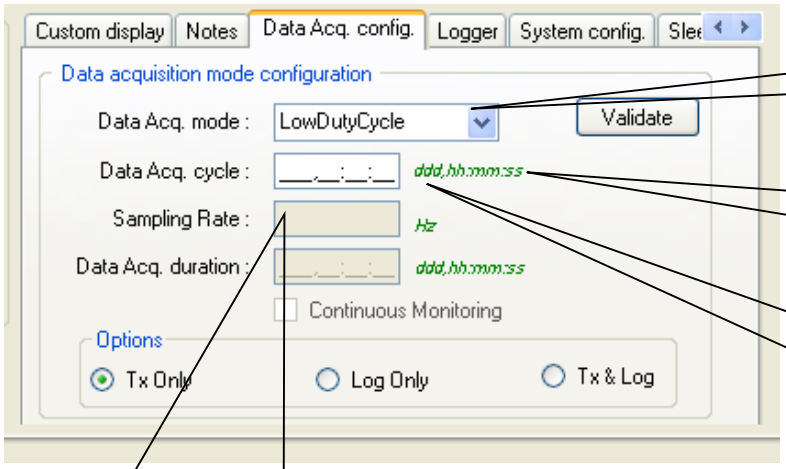
V (version) related to a major modification of the embedded software.

R (Release) related to a minor modification of the embedded software

These ID versions should be transmitted to our technical support center when you encountered a material or software dysfunction.

11.2.7 Frame : Current Data Acquisition mode

This frame displays all the informations returned by the BeanDevice® on its actual data acquisition mode:



Data acquisition mode available on the BeanDevice®

Data acquisition cycle in Day, hour, minute and second

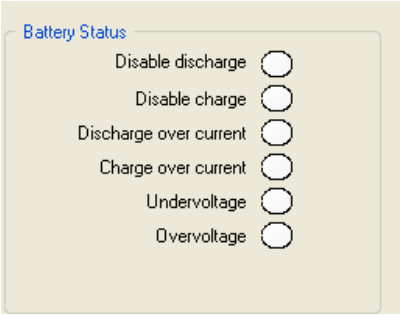
BeanDevice® sampling rate in Hz (available only for streaming mode and streaming packet mode only)

Data acquisition duration (available only for streaming mode and streaming packet mode)

11.2.8 Frame : Battery/Primary Cell status

This frame displays information on battery/primary cell status.

The BeanDevice® performs frequently a battery diagnostic on the BeanDevice®. An alarm notification is transmitted automatically to the BeanScape® if a battery failure is detected on the BeanDevice®.



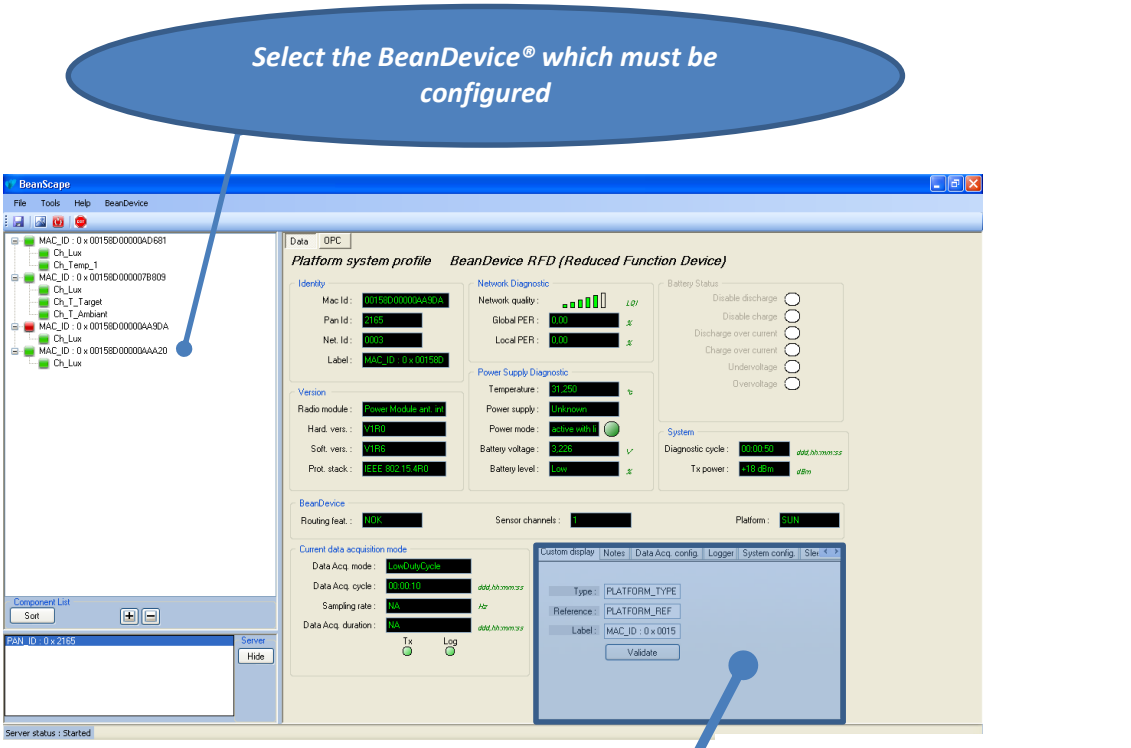
If any battery status information is displayed (ex: the BeanDevice® is not connected), status led is white.

When LEDS are green a normal state is indicated. During a malfunction, the LEDS turns red.

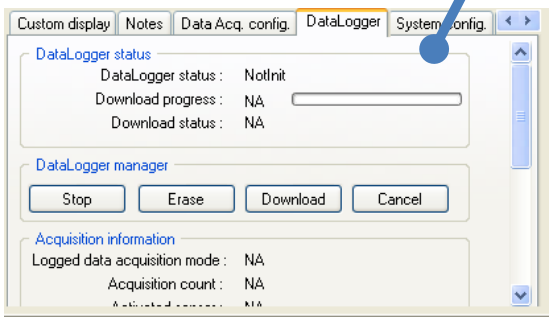
Here are the details:

Led definition	Green Led signification	Red led signification
Disable Discharge	Battery discharge activated	Battery discharge deactivated
Disable Charge	Battery charge activated	Battery charge deactivated
Over current during battery discharge	No over current during battery discharge	Over current during battery discharge detected
Over current during battery charge	No over current during battery charge	Over current during battery charge detected
Overvoltage	Any presence of battery overvoltage	Battery over voltage detected on the battery
Under voltage	Any presence of battery under voltage	Battery under voltage detected on the battery

11.3 BEANDEVICE® CONFIGURATION


Select the BeanDevice® which must be configured
BeanScape
File Tools Help BeanDevice
Platform system profile
BeanDevice RFD (Reduced Function Device)

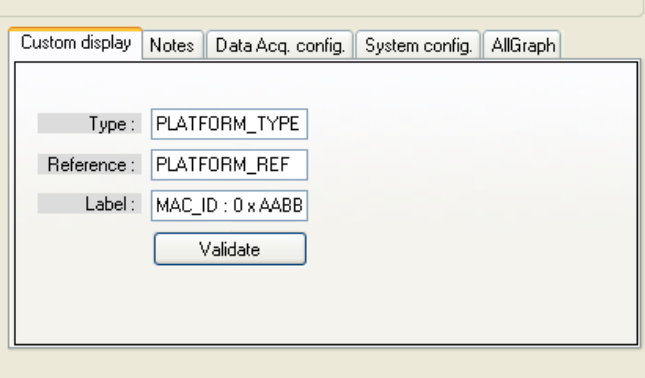
BeanDevice® Configuration frame



This frame is composed of several Tabs and includes BeanDevice® OTAC (Over the Air Configuration) Parameters:

Tab	Description
Custom Display	Customize the BeanDevice® label
Notes	This area contains the notes related to the BeanDevice®.
Data Acquisition configuration	Configure the Data acquisition mode on your BeanDevice®, set the acquisition cycle or the sampling rate, enable/disable the datalogger function .
Datalogger	Manage the Datalogger function on the BeanDevice®
System configuration	Configure the diagnostic cycle and the TX Power
Power Mode Management	Configure the Power mode on your BeanDevice® (Active mode, Sleep, Sleep with network listening)

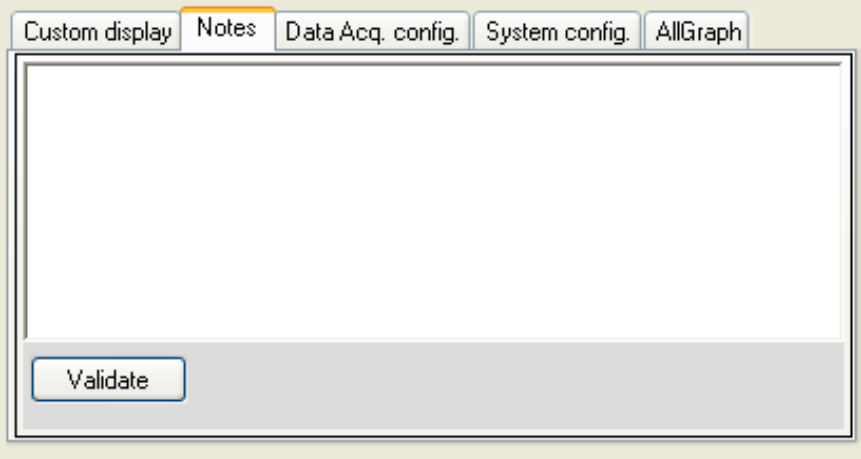
11.3.1 Tab: Custom Display



Parameter	*Description*
Type	You can enter here the type of BeanDevice® you want to use
Reference	You can assign an internal reference to the BeanDevice® you have purchased.
Label	You can assign any sort of Label to your BeanDevice®. Therefore, the user can easily associate the BeanDevice® with its equipment (example: Room_N521_Second_Floor)

Click on "***Validate***" if you want to validate your configuration.

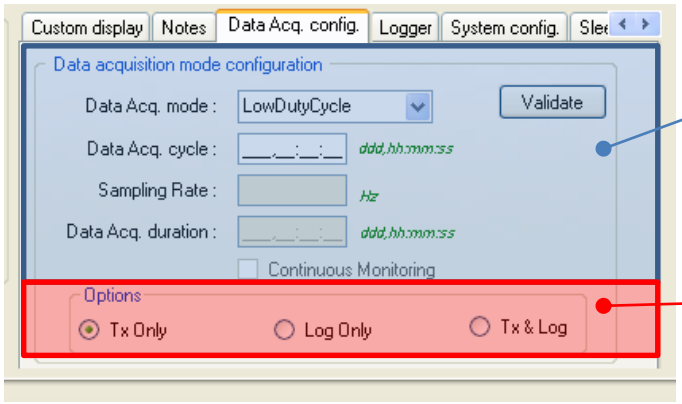
11.3.2 Tab: Notes



This field contains your notes concerning the BeanDevice®. To change this field, enter your text and click on « ***Validate*** » button. To backup your text, press the icon

Example: Machine failure n°XX, requested intervention.

11.3.3 Tab : Data Acquisition configuration

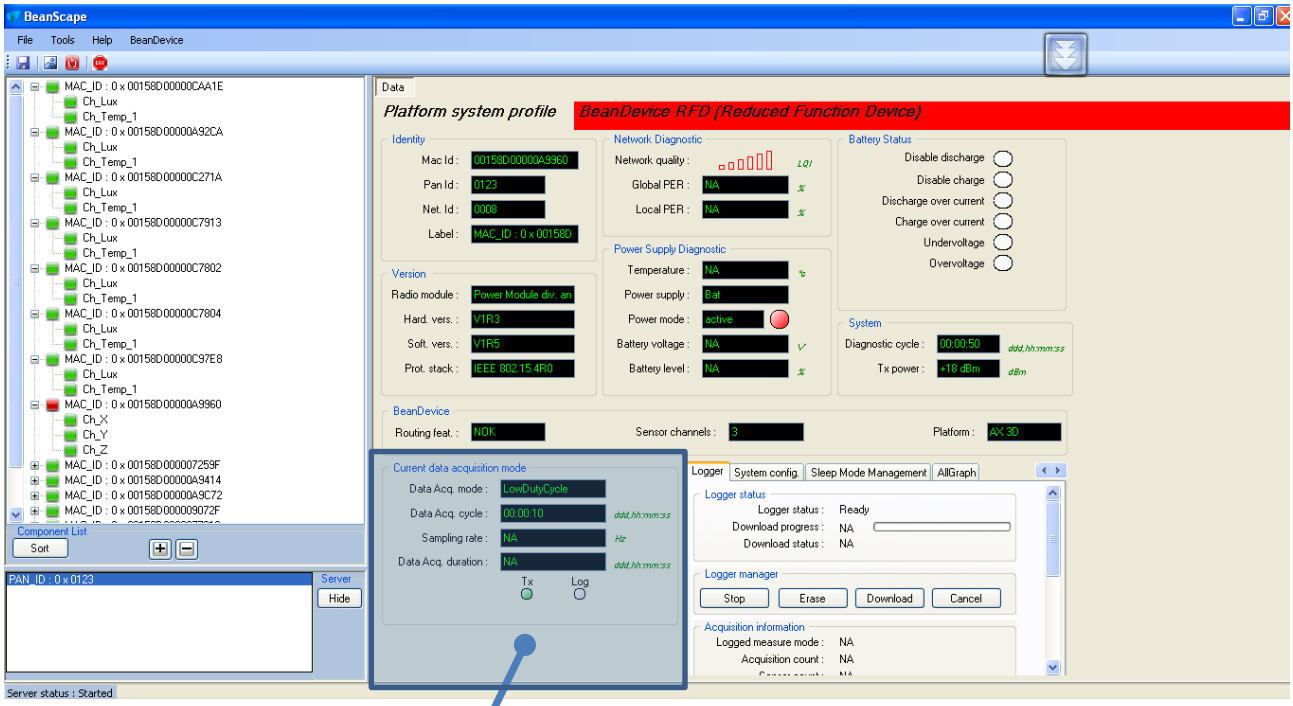


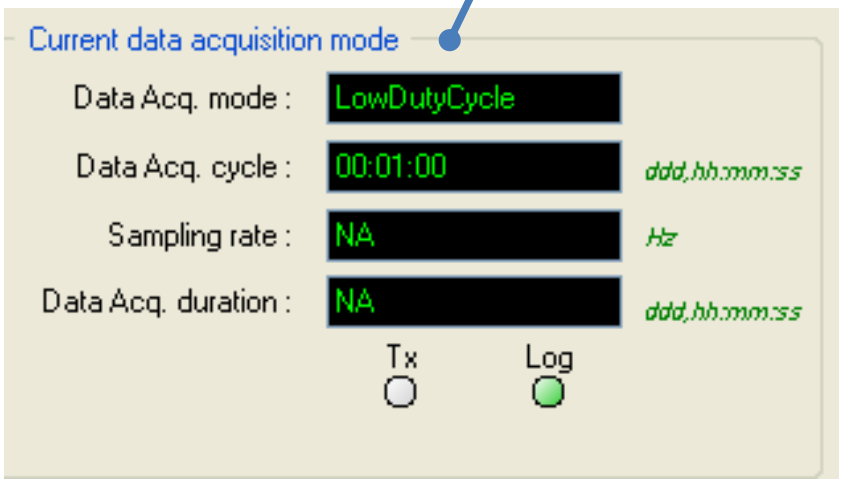
Parameter		Description
Data Acquisition mode	*Low duty cycle Data Acquisition (LDCDA)*	Low duty cycle data acquisition is adapted for static measurement (tilt, pressure, temperature) requiring a low power consumption on your BeanDevice®. The duty cycle can be configured between 1 data acquisition & transmission per second to 1 data acquisition & transmission per day.
	Alarm	Data acquisitions are transmitted by radio whenever an alarm threshold (fixed by the user) is reached (4 alarms threshold levels High/Low).
	Survey	Survey mode is a mix between the LDCDA mode and Alarm mode. A data acquisition is transmitted ▪ Whenever an alarm threshold (fixed by the user) is reached (4 alarm threshold levels High/Low). ▪ A transmission cycle is reached, the transmission cycle is configurable through the BeanScape® 1s to 24h ;
	Streaming Packet	Streaming packet is more suitable for users requiring a high data sampling rate (maximum 5 KHz). In order to achieve these performances, data sampling are transmitted by packet;
	Streaming	Streaming mode is more suitable for users requiring a real-time data transmission (with time latency under 10ms).
Data acquisition Cycle		Select the Data acquisition cycle between 1s and 24hours. The format is: Day : Hour : Minute :Second

Sampling rate	Select the sampling rate of your BeanDevice® between 1 sample per second and 5000 Samples per second maximum. The resolution is 1 sample per second. If DataLogger is selected, the maximum sampling rate is 2000 samples per second. This field is available in streaming, streaming packet: Choose carefully the Sampling rate value: ✓ The PER (Packet Error Rate) can increase if the Sampling rate is high on your BeanDevice®. For further information read the technical note ***RF_TN_003 V1.0- "Wireless Network capacity"*** ✓ Power consumption increases with the sampling rate of your BeanDevice®
Data acquisition duration	Data acquisition duration in streaming, streaming packet modes. The format is Day : Hour : Minute :Second The Data acquisition duration value can be higher than Data acquisition cycle.
Options	***Tx only***: The BeanDevice® transmits the data acquisition without Datalogging ***Log only***: The Beandevice® logs the data acquisition without wireless transmission ***Tx & Log***: The BeanDevice® transmits and logs the data acquisition; For further information about the DataLogger feature, read the technical note TN_RF_007 – "BeanDevice® DataLogger User Guide "

For further information about the Datalogger, please read the technical note TN_RF_007 – "BeanDevice® DataLogger User Guide "

All the modifications are displayed on "***Current data acquisition mode***" frame:

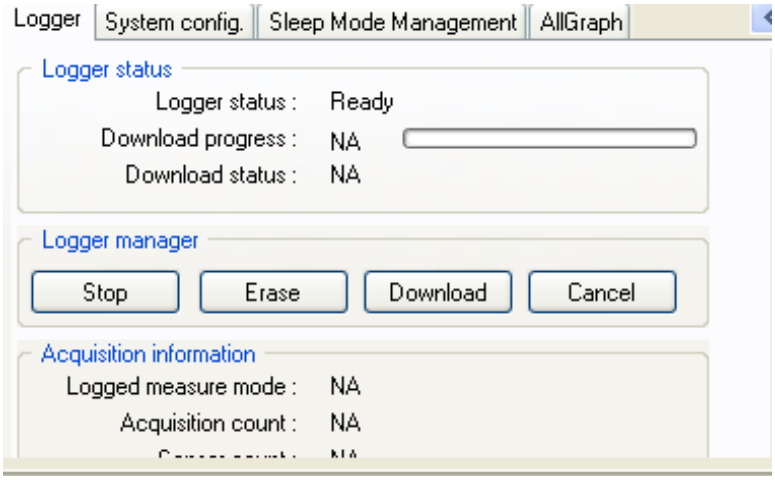



Current data acquisition mode
Data Acq. mode : LowDutyCycle
Data Acq. cycle : 00:01:00 ddd,hh:mm:ss
Sampling rate : NA Hz
Data Acq. duration : NA ddd,hh:mm:ss
Tx
Log

For further information, please read the technical note TN_RF_008 – "Data acquisition modes available on the BeanDevice®"

11.3.4 Tab: DataLogger

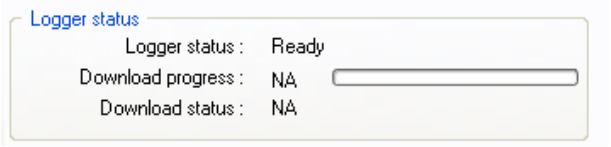
For further information about the Datalogger, please read the technical note TN_RF_007 – "BeanDevice® DataLogger User Guide "



The Logger tag is composed of five different fields:

- ***Logger Status***
- ***Logger manager***
- ***Acquisition information***
- ***Logger memory configuration***
- ***Logger status***

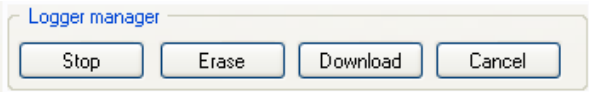
11.3.4.1 Logger status



- ***Logger status***: Displays loggers status, four status are available:
  - ***Ready***: the Datalogger is ready to register data
  - ***NotInit***: the Datalogger is not initialized;
  - ***Active logs only***: Data acquisition is logged only;
  - ***Active Tx and Log***: Data acquisition is logged & transmitted by Radio;
  - ***Stopped***: Datalogger is stopped;
- ***Download process***: Displays the download process 0 to 100%. If 100%, all the data logs are successfully downloaded on your PC.

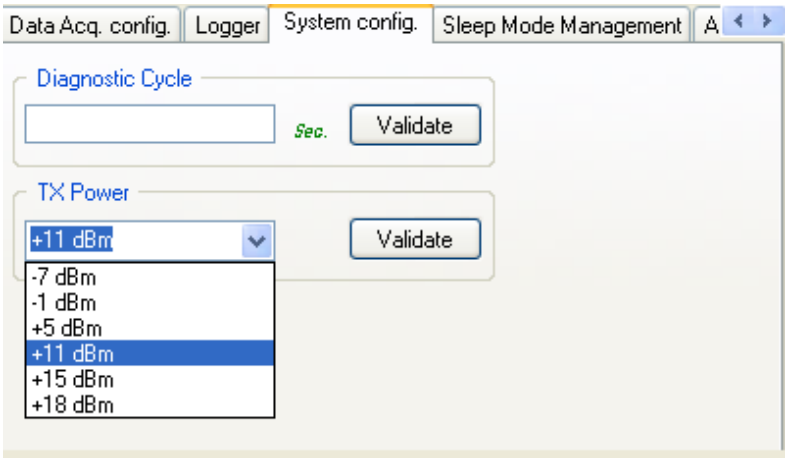
- ***Donwload status***: Displays the download status , two types of status are available:
  - ***Processing***: Data logs download is under process;
  - ***Completed:*** Data Logs are completely downloaded on your PC;

11.3.4.2 Logger manager



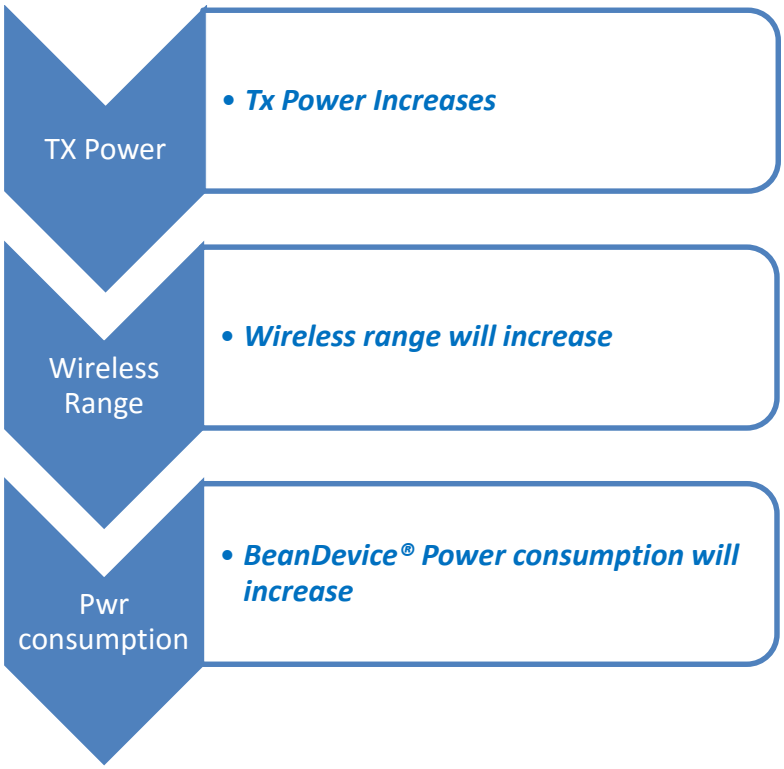
- ***Stop***: Stops Data Logging process
- ***Erase***: Stops & Erases all the logs on flash memory
- ***Download***: Starts to download all the logs on the flash memory
- ***Cancel***: Stops the download process

11.3.5 Tab : System config.



Parameter	Description
Diagnostic cycle	You can set the BeanDevice® diagnostic cycle (Battery status, LQI, PER ...). The Diagnostic cycle is a ratio of the data acquisition cycle. ***Ex***: If you try to set the diagnostic cycle at 10s while the data acquisition cycle is set at 20s, the diagnostic cycle will be setted to 10s ;
TX Power	BeanDevice® TX Power unit is in dBm, it represents the power ratio in decibels (dB) of the measured power referenced to one milliwatt (mW). The antenna radio power is not included. If the BeanDevice® PER is high or the LQI is too low, try to increase the transmission power.

The following flow chart shows the effect of a higher TX power:



Recommendations:

- ✓ *If you fix the TX power at its minimum value (-7dBm): you will lose the radio link between your BeanGateway® and the BeanDevice®, if the wireless range is more than 5m,*
- ✓ *By pressing the Network push button for more than 2s, you can reset to factory settings (default RF power is fixed at its maximum: 18 dBm).*

How to convert dBm to mW

Zero dBm equals one milliwatt. A 3dB increase represents roughly doubling the power, which means that 3 dBm equals roughly 2 mW. For a 3 dB decrease, the power is reduced by about one half, making –3 dBm equal to about 0.5 milliwatt. To express an arbitrary power P as x dBm, or go in the other direction, the following equations may be used:

$$x = 10\log_{10}(1000P) \text{ or, } x = 10\log_{10}P + 30$$

and

$$P = 10^{(x/10)}/1000 \text{ or, } P = 10^{(x-30)/10}$$

where P is the power in W and x is the power ratio in dBm.

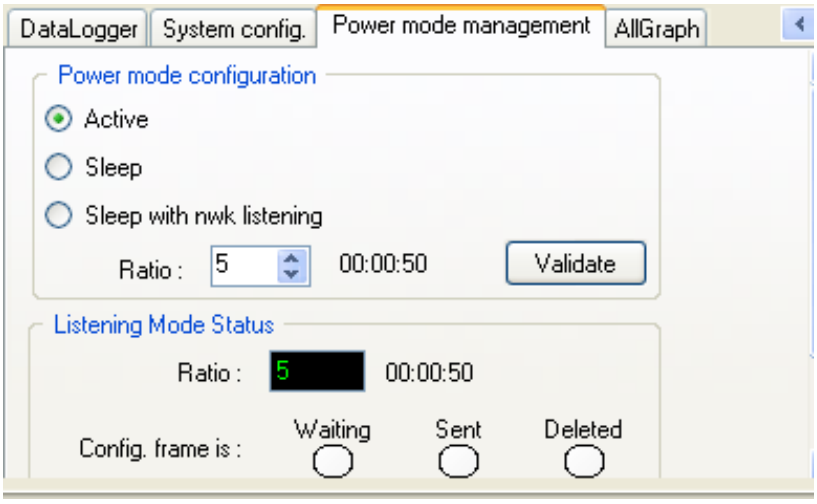
Inside a building, the maximum authorized power is +12 dBm (antenna power included). It is highly recommended to follow the R&TTE guidelines. For more information please visit http://www.etsi.org. It is your responsibility to carefully observe the R&TTE guidelines.

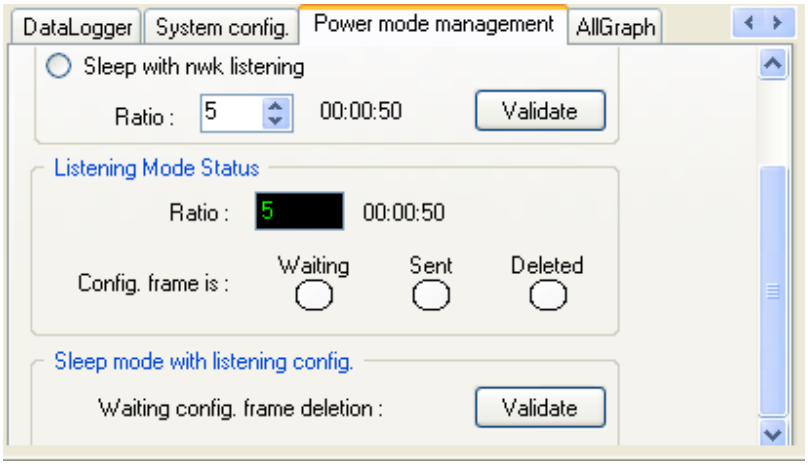
11.3.6 Tab : Power mode management

For further information about Power mode management, please read the technical note TN_RF_010 – « BeanDevice® Power Management »

This Tab is composed of three frames:

- ✓ ***Power mode configuration:*** Configure the Power mode on your BeanDevice®
- ✓ ***Listening Mode Status :*** Describes the status of an OTAC (Over-the-air-Configuration)
- ✓ ***Sleep with listening config. :*** Configuration settings for Sleep with network listening

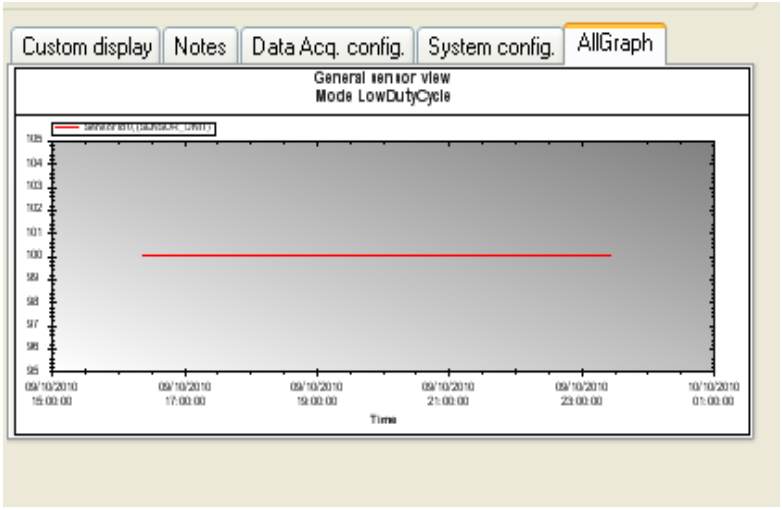




Parameter	Description
Power mode configuration	***Active:*** Sleeping mode is disabled. The BeanDevice® operates in Active power mode. ***Sleep:*** Sleeping mode is enabled ***Sleep with nwk listening:*** Sleep with network listening mode is enabled. ***Ratio***: Fix the Ratio of the listening cycle. This ratio depends on the data acquisition low duty cycle.
Listening mode status	***Ratio***: displays the latest Ratio value ***Waiting***: This led is ***green*** if an OTAC (Over-the-Air configuration) frame is pending for a transmission to the BeanDevice® ***Sent***: This led is ***green*** if an OTAC (Over-the-Air configuration) frame is transmitted to the BeanDevice®. ***Deleted***: This led is ***red*** if a pending OTAC (Over-the-Air configuration) is deleted
Sleep with network listening config	By clicking on "validate", the pending OTAC frame is deleted

11.3.7 Tab : AllGraph

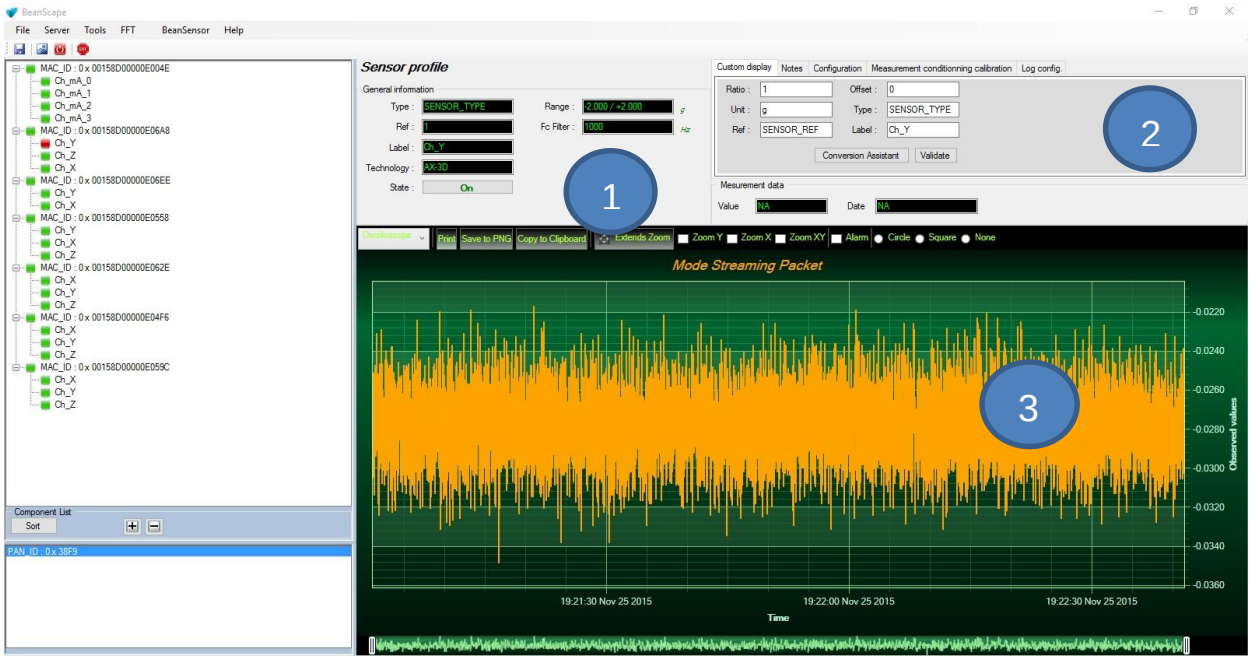
Allgraph mode allows displaying all the sensors curves of a BeanDevice® on the same graph.



11.4 SENSOR CHANNEL PROFILE

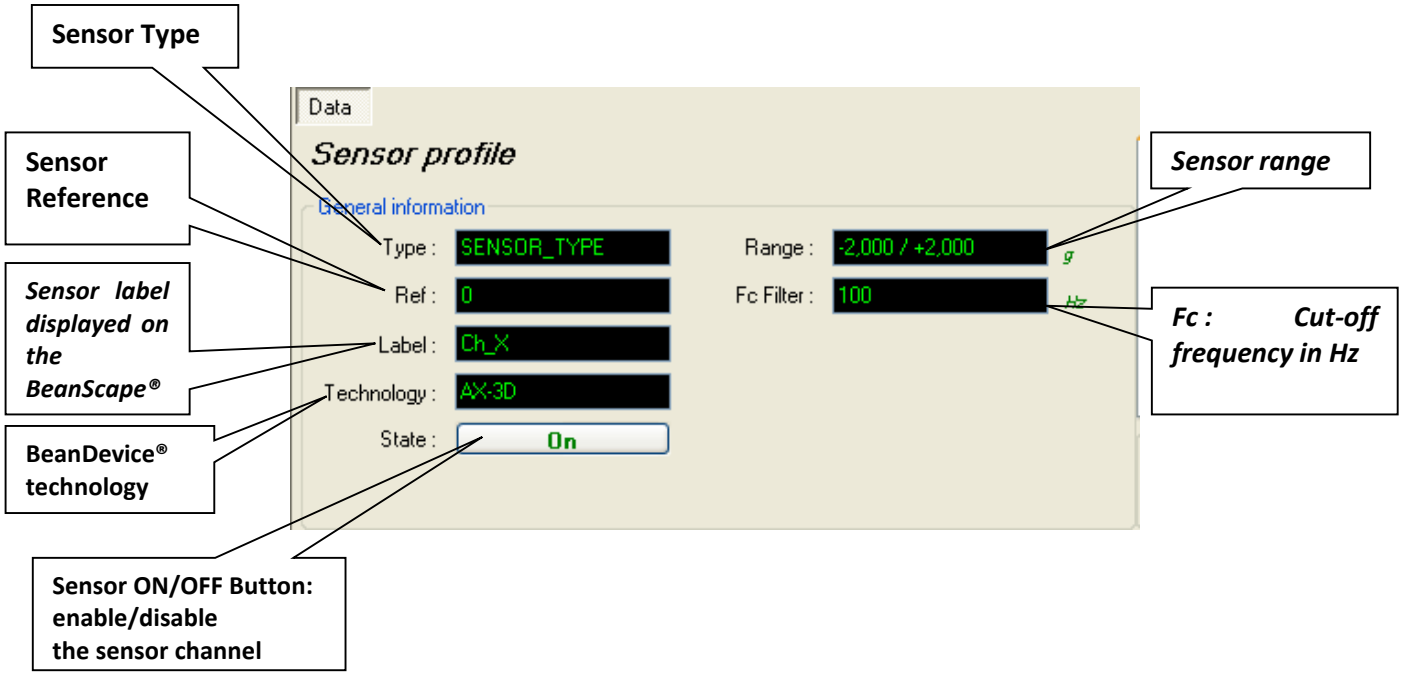
The screen « ***Sensor channel profile*** » consists of three parts:

1. ***General information on the measurement channel;***
2. ***Measurement channel configuration;***
3. ***A graph which displays in real-time sensor signals during data acquisition;***

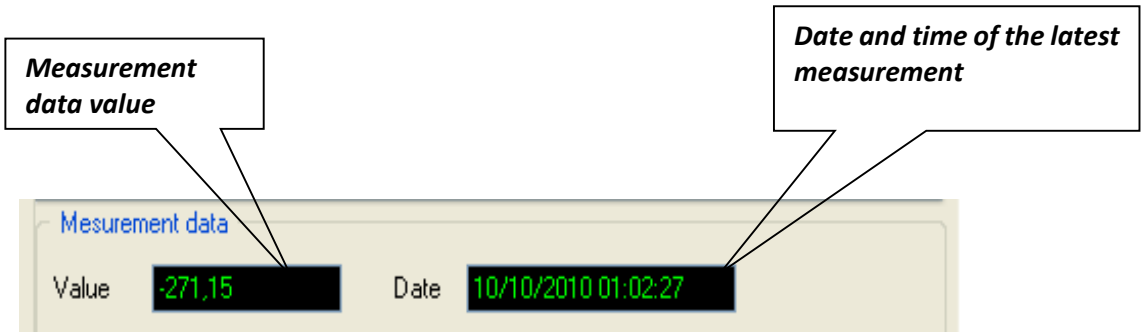


11.4.1 Sensor channel status

11.4.1.1 Frame : General informations



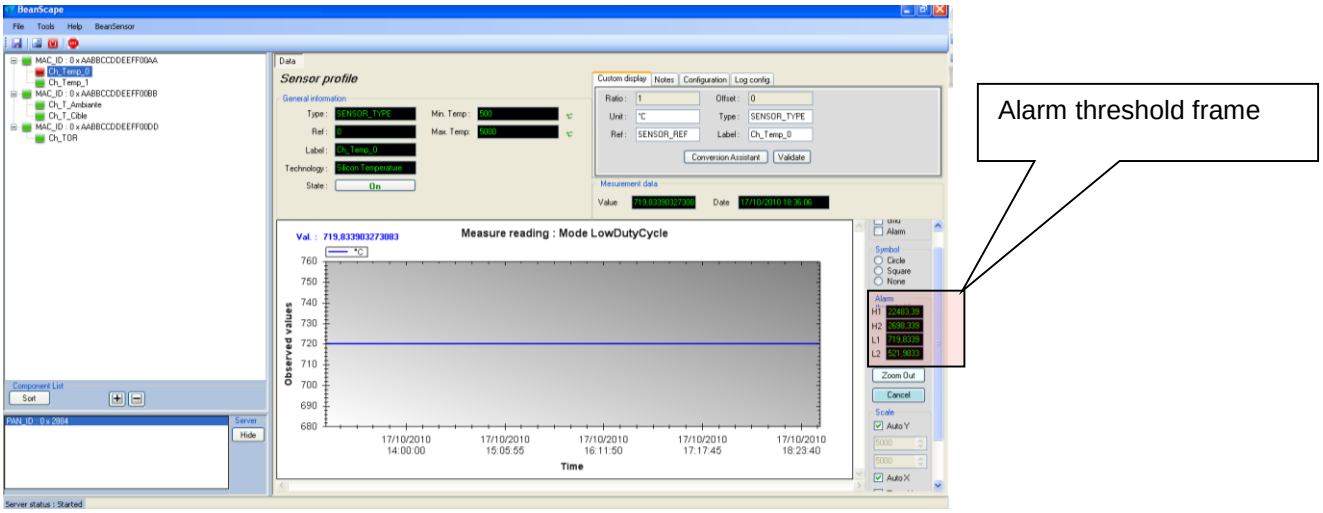
11.4.1.2 Frame: Measurement data



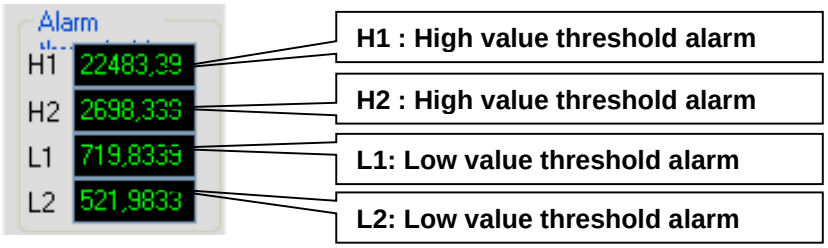
By default, sensor unit format is

- g for the BeanDevice AX-3D & AX-3DS
- ° for the BeanDevice HI-INC

11.4.1.3 Frame : Alarm threshold



Alarm threshold are displayed in this frame:



Depending on your sensor resolution, the displayed threshold value can differ from the reference value.

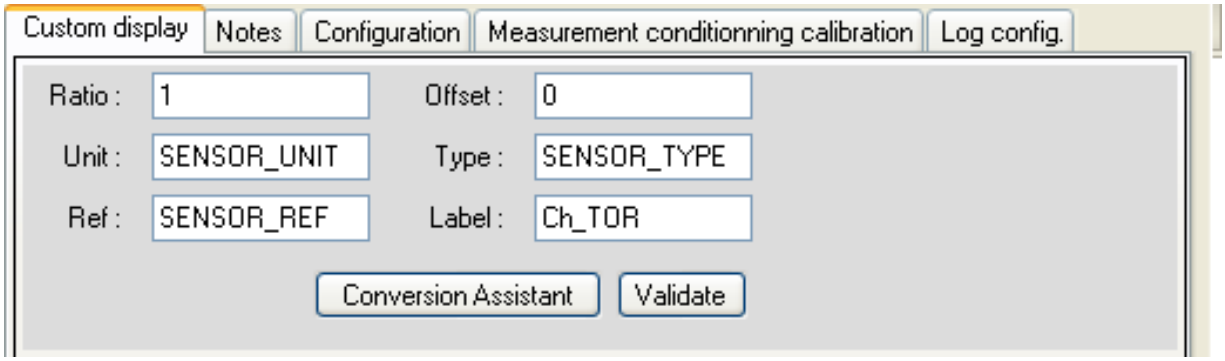
11.4.2 Sensor channel configuration

This frame contains a set of 5 tabs:

Custom Display	• Allows the end user to customzie the sensor
Notes	• Contains notes relating to the BeanDevice® sensor
Configuration	• Sensor configuration interface. The user can configure the alarm thresholds related to the sensor • Depending on the BeanDevice® version which is used, other configuration parameters are available
Sensor calibration	• Sensor channel calibration
Log configuration	• Logs configuration on the BeanScape®

11.4.2.1 Tab: Custom display

These parameters allow the user to customize his sensor:



- ✓ ***Type***: Describe the sensor type (ex: load cell, pressure, Strain gage +/- 2 Mv/v, LVDT,….)
- ✓ ***Unit***: customer sensor unit (bar, °C, l/h….)
- ✓ ***Ratio*** : Sensor Ratio coefficient (***RAT***);
- ✓ ***Offset*** : Sensor Offset coefficient (***OFF***);
- ✓ ***Label***: Give a name to your sensor. (***ex*** : Sensor on StatorMachine 1, sensor in Room 2 Floor 3)

Measurement conversion formula:

Converted Measurement = Measurement x RAT + OFF

Example with a temperature sensor: By default the temperature unit is in degree Celsius. The user wants to convert the unit in degree Fahrenheit.

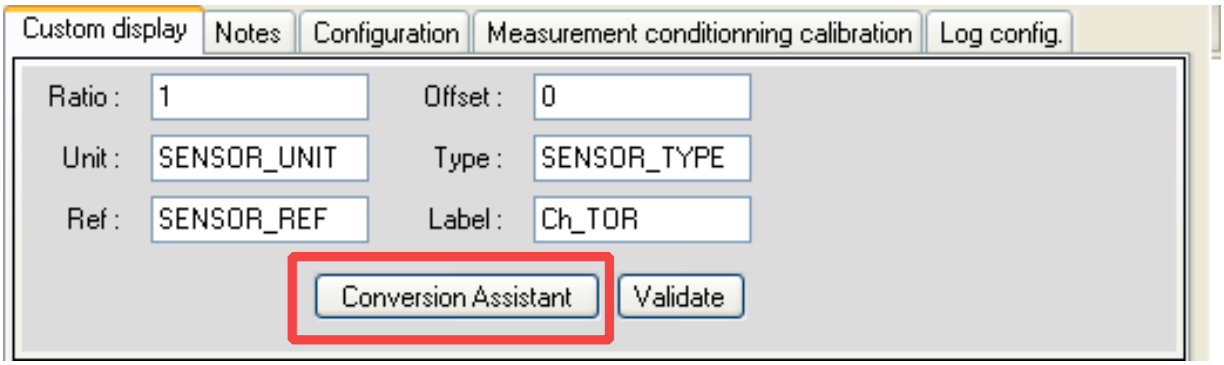
Converted Measurement [°F] = Measurement[°C] x RAT + OFF

With **RAT** = 1.8 and **OFF** = 32

Conversion assistant

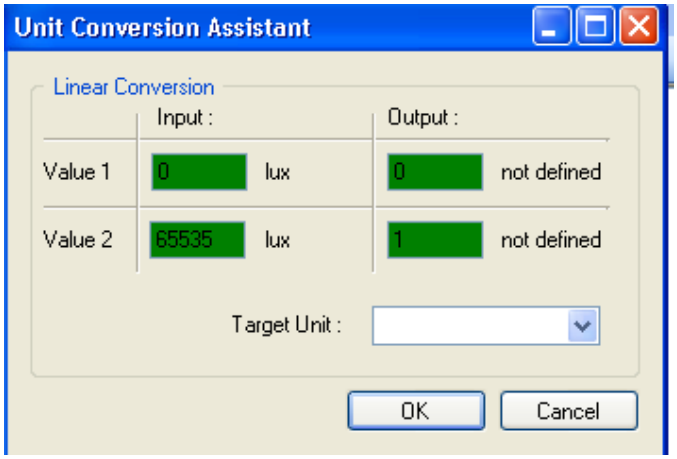
To avoid conversion error, a conversion assistant is available to help you to setup quickly your measurement channel of your BeanDevice®.

Click on conversion assistant from the tab "***Custom display***", a window will open allowing you to do a linear conversion.

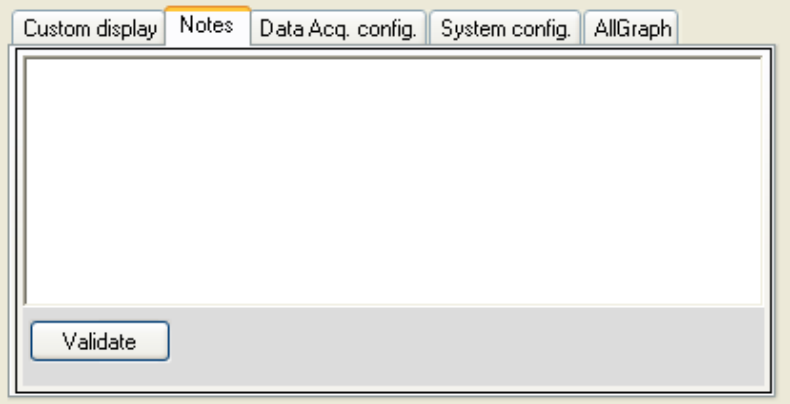


On the left column, the user can enter the non-converted measurement data. On the right column, the user can enter the converted measurement values with the desired unit.

The ratio and offset values are calculated automatically by the conversion assistant.

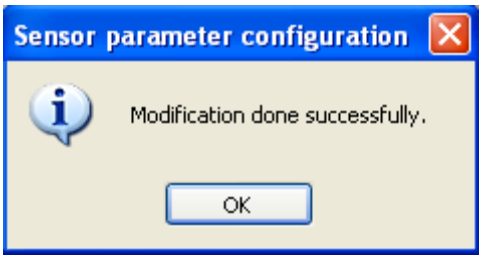


11.4.2.2 Tab : Notes



This field contains notes relating to the BeanDevice® sensor. To change this field, enter a value or free text and click the "Validate" button.

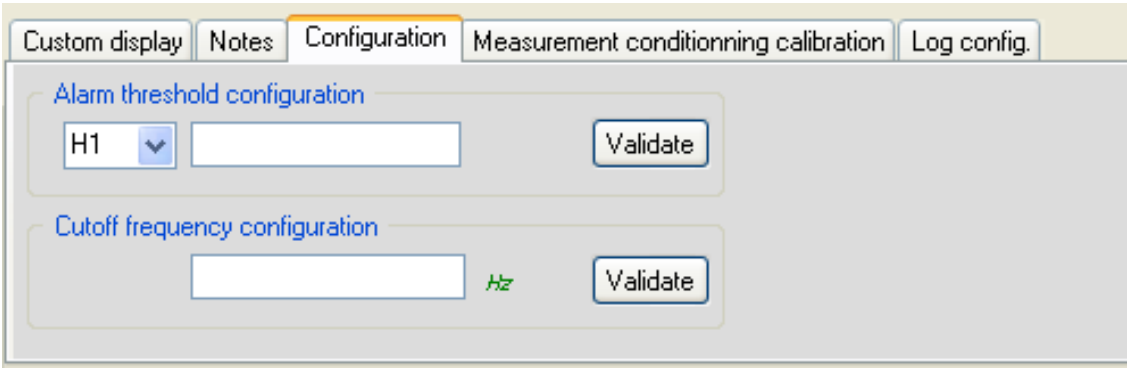
A new window opens; accept your modifications by clicking on "OK".



To backup your text click on the icon "Backup your Database"

11.4.2.3 Tab: Configuration - BeanDevice® AX-3D and BeanDevice® HI-INC

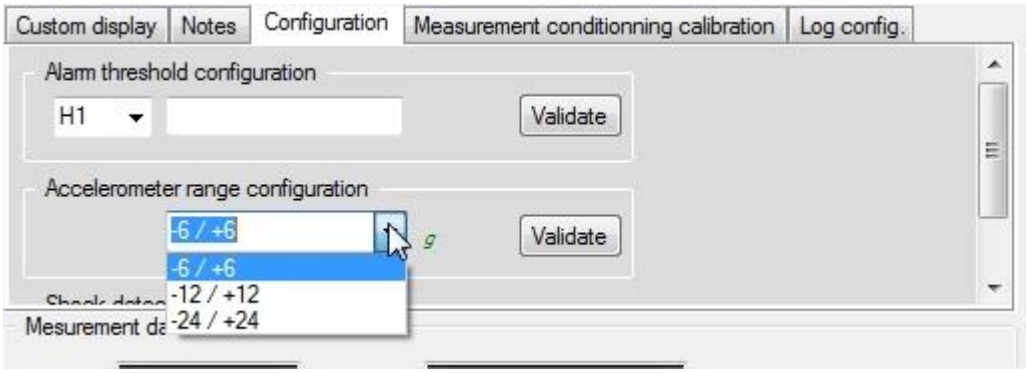
For further information about the alarms threshold configuration, please read the technical note TN_RF_008 – "Data acquisition modes available on the BeanDevice®"



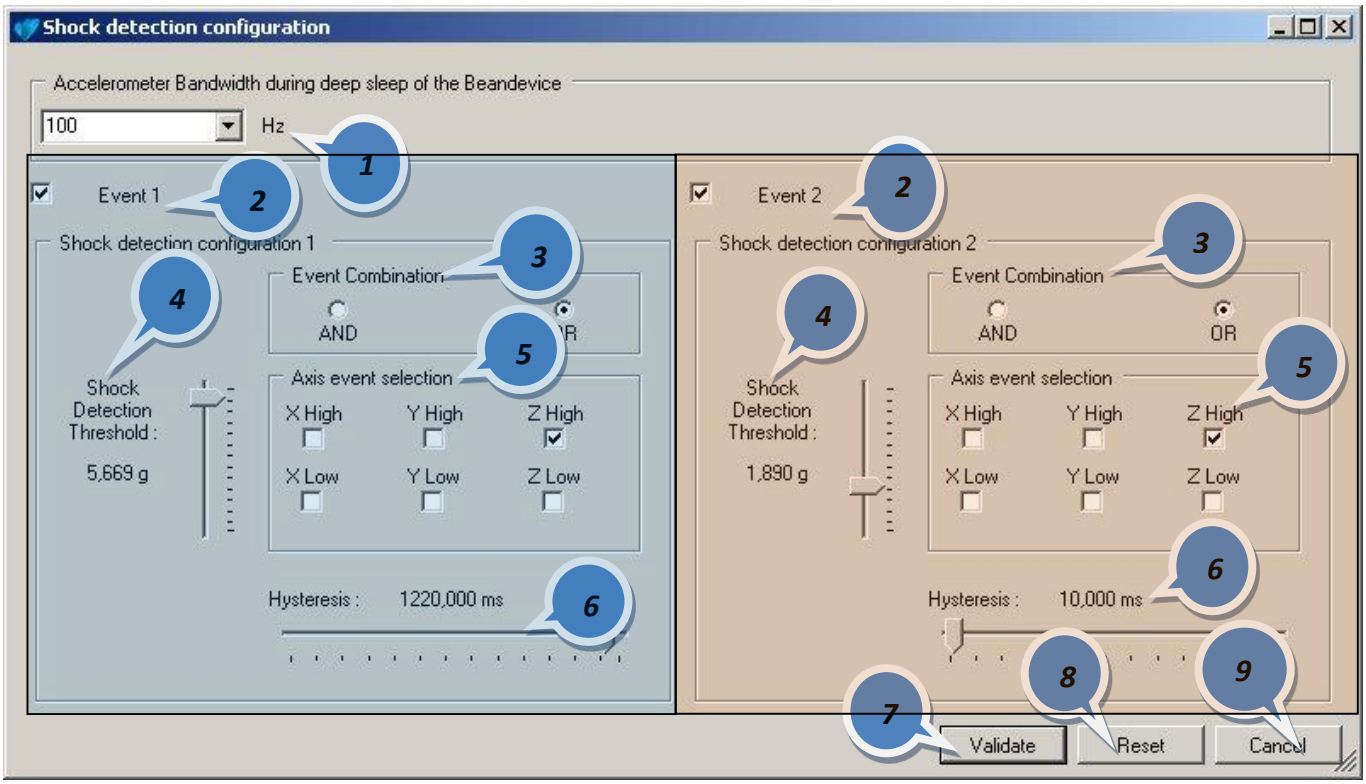
Parameter	*Description*
Alarm threshold	You can configure threshold high values (H1, H2) and low values (L1, L2) . In alarm mode, when a higher low threshold value is reached, an alarm notification is transmitted to the BeanGateway ; ✓ If the sensor value is higher than H1/H2, an alarm notification is send to the BeanGateway/BeanScape; ✓ If the sensor value is lower than L1/L2, an alarm notification is send to the BeanGateway/BeanScape;. Threshold values must be organized in this manner: H2>= H1 > L1>=L2
Cutoff Frequency	***Cutoff frequency :*** Configure the anti-aliasing filter cutoff frequency The range of cutoff frequency which can be configured is: ✓ ***0 Hz to 2 KHz*** if the product is a BeanDevice AX-3D ✓ ***0 Hz to 2 KHz*** if the product is a BeanDevice AX-HD ✓ ***0 Hz to 60 Hz*** if the product is a BeanDevice HI-INC

11.4.2.4 Tab: Configuration - BeanDevice® AX-3DS

For further information about the SSD (Smart Shock Detection) measurement mode, read the technical note TN_RF_008 – "Data acquisition modes available on the BeanDevice®"

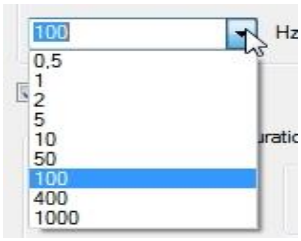


Parameter	Description
Alarm threshold	You can configure threshold high values (H1, H2) and low values (L1,L2) . In alarm mode, when a higher low threshold value is reached, an alarm notification is transmitted to the BeanGateway ; ✓ If the sensor value is higher than H1/H2, an alarm notification is send to the BeanGateway/BeanScape; ✓ If the sensor value is lower than L1/L2, an alarm notification is send to the BeanGateway/BeanScape;. Threshold values must be organized in this manner: H2>= H1 > L1>=L2 ***Alarm thresholds are not available for SSD (Smart shock detection mode)***
Accelerometer range configuration	✓ The user can change the measurement range of the accelerometer: • ***BeanDevice® AX-3DS 24G***: ±6g or ±12g or ±24g • ***BeanDevice® AX-3DS 8G*** : ±2g or ±4g or ±8g
Shock detection configuration	Click on modify, a new window will open.



Shock detection configuration 1

Shock detection configuration 2

1	Changes the accelerometer bandwidth during the sleeping of the Beandevice®: 
2	The user can select two events profile ***Event 1*** and ***Event 2.***
3	***Event combination*** The user can use two logical combinations: ***AND*** and ***OR*** combination on the axis event selection.
4	***Fix the shock detection threshold*** Unit value: g The resolution of the threshold value depends on the acceleration range of the accelerometer. On the axis event selection frame, if the High Axis is selected, the value of the threshold will be positive. If the Low axis is selected, the value of the threshold will be negative. ***Example***: For a threshold value fixed at 2g, if X High Axis **OR** X Low Axis is selected. For all the values upper than 2g on the X Axis, a shock event is detected For all the values less than -2g on the X Axis, a shock event is detected.

5

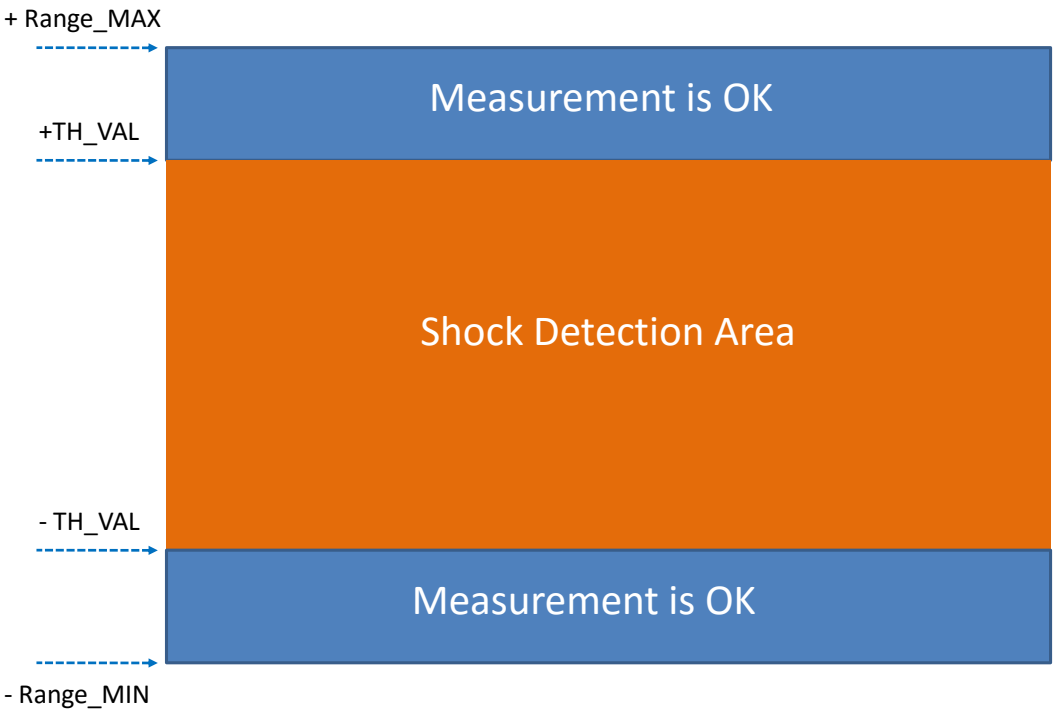
Axis event selection

The user can choose on which axis the shock event is affected: X Axis High, X Axis Low, Y Axis High, Y axis Low, Z Axis High, Z Axis Low.

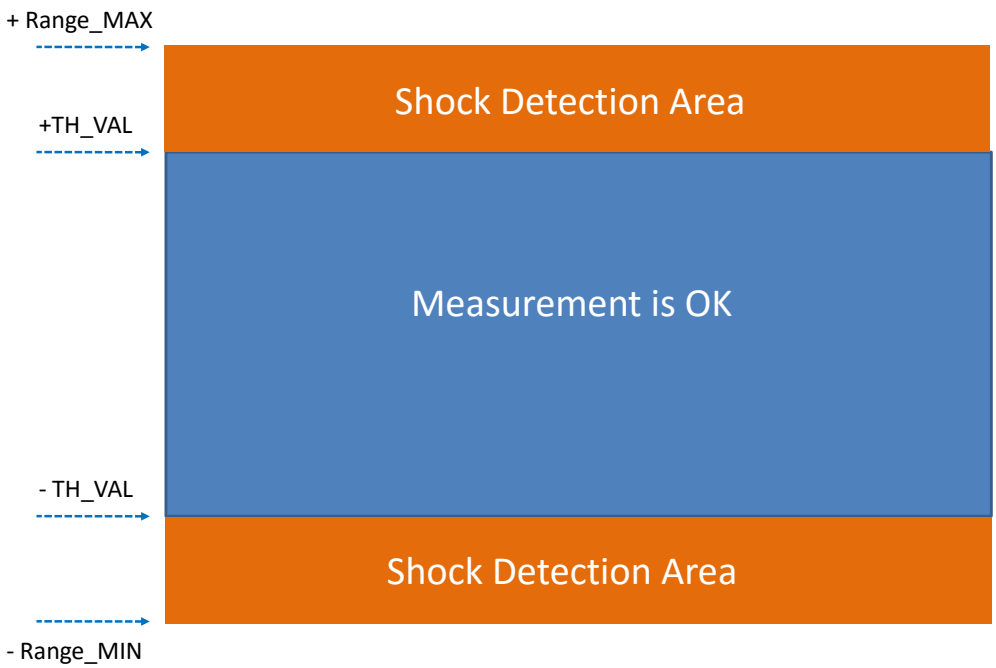
The combination **AND/OR** is not available for two events on the same axis, i.e. these combinations are not possible: X High **and/or** X Low, Y High **and/or** Y Low, Z High **and/or** Z Low.

Several configuration of shock detection are possible on the same axis:

- The user selects ***XX Axis Low, all the shocks are detected*** on the following acceleration range [-TH_VALUE ;+TH_VALUE];



- The user selects XX Axis High , ***all the shocks are detected*** on the following acceleration range [Range_MIN ; -TH_VAL] and [+TH_VALUE; Range_MAX];

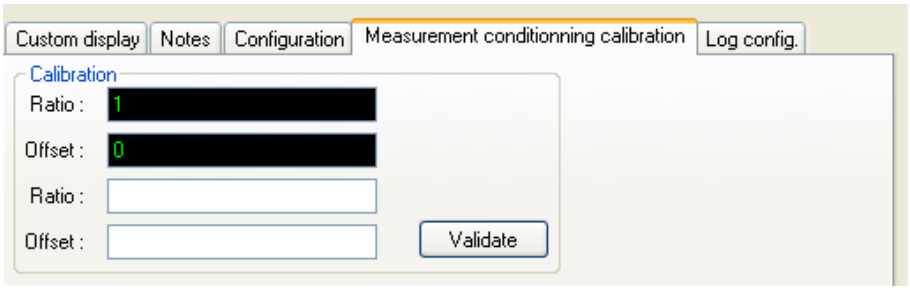


- The user selects a high event on the axis (+TH_VALUE), a shock is detected if the threshold value +TH_VALUE is reached:

6	***Hysteresis*** The user can fix an hysteresis on threshold value Choose closely the value of the hysteresis. The resolution depends on the accelerometer bandwith during sleep or deep sleep.
7	***VALIDATE*** Click here to validate your new configuration
8	***RESET*** Click to restore a default configuration
9	***CANCEL*** Click here to cancel your configuration

11.4.2.5 Tab : Sensor calibration

These coefficients are used to calibrate the ***internal accelerometer/inclinometer*** sensors:



The BeanScape® provides a calibration interface for each measurement channel:

- ***Ratio*** : multiplier coefficient
- ***Offset***: adder/subtracted coefficient. its unit is the sensor unit

Calibrated_value = (Ratio x Non_Calibrated_Value) + Offset

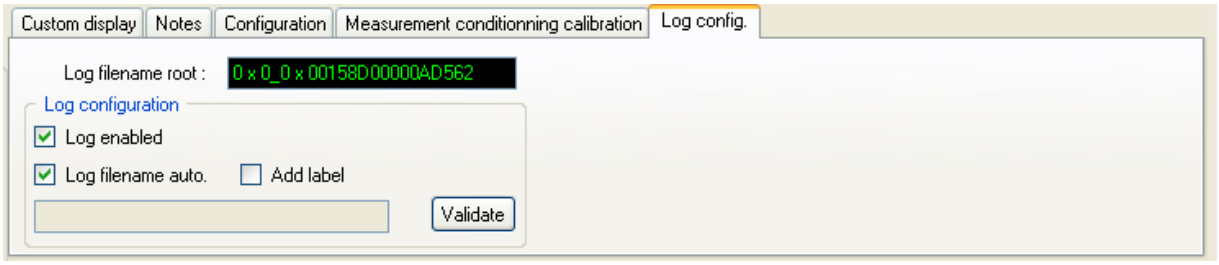
Enter the calibration coefficients and then click on validate.

The calibrations coefficients are backed up on the BeanDevice® flash memory and are preserved during the lifetime of your product.

WARNING: These calibration coefficients should be accessible to an advanced user. A wrong calibration will result in false measurements.

11.4.2.6 Tab: Log configuration

This tab should not be confused with the DataLogger feature available on the Beandevice®:



By default, Log file name is built with the measurement channel & BeanDevice® MAC Address:

< ***Sensor Channel Number*** > < ***MAC_ID*** >

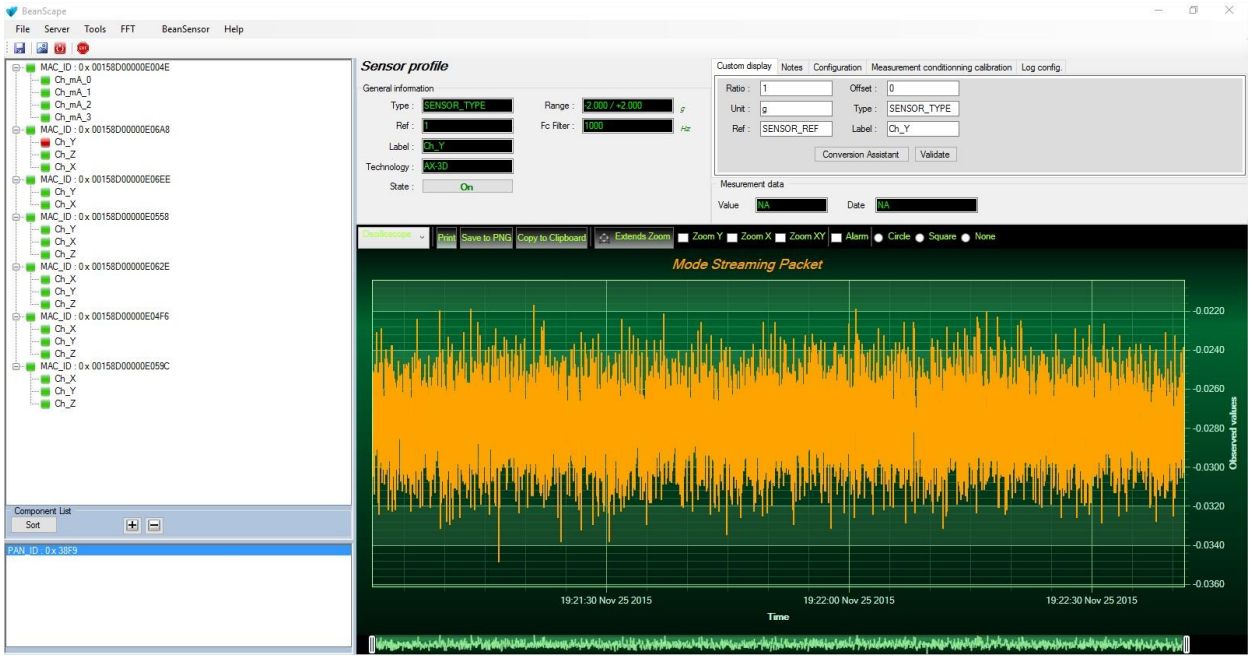
- ✓ ***Log enabled***: If checked, Log is enabled on the BeanScape®
- ✓ ***Log filename auto***.: If checked, Log file name is named automatically
- ✓ ***Add label***: If checked, the log file is renamed with the sensor label

Click on ***validate*** in order to validate all your modifications.

For users who want to rename the log file, two solutions are provided:

Solution 1	***Add automatically the channel "Label" in your log file name:*** ***<Label><Sensor channel Number> <MAC_ID>***
Solution 2	***The log file name can be fully customized:*** ***Uncheck the case « Log filename auto" and add your own label***

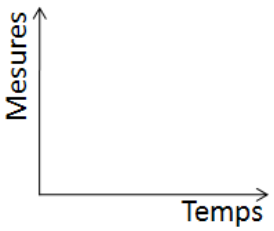
11.4.3 Graphical display



The chart is composed of two parts:

- ***Part 1***: This is a preview window, allowing you to observe sensors acquisitions:
- ***Part 2***: A strip on the side composed of different frames allows customizing the graph;

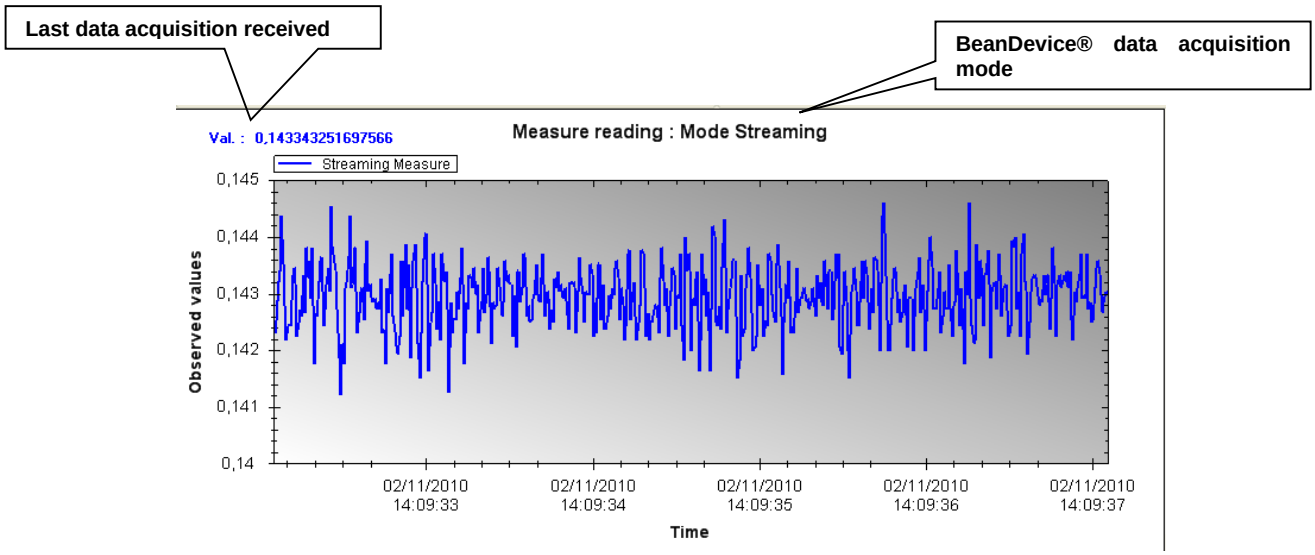
The graph has two axes:



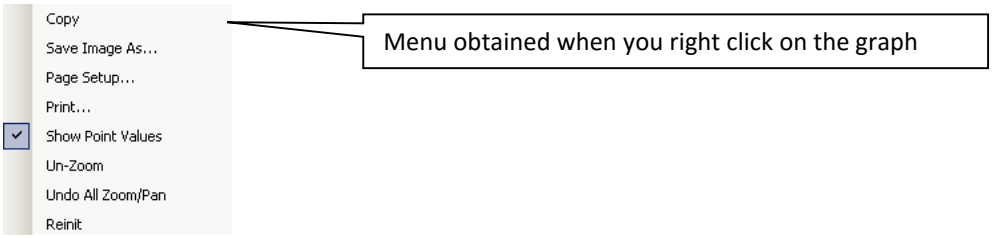
Axe-X: Timeline

Axes-Y: received sensor acquisitions

We can visualize the BeanDevice® data acquisition mode, and the last data acquisition obtained directly from the graph:

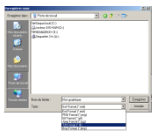


A right click on the graph allows a set of actions:



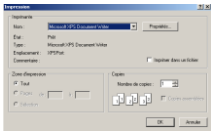
The meaning of each field of the menu is:

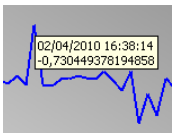
Copy: Copies the graph to the clipboard

Save Image As …: Save your graph 

The application offers a wide choice of type, for recording your graphs

Page Setup…: Use page setup to fine-tune pages before printing

Print …: Select your printer and start printing 

Show Point Values: Enabling this option allows you to see the detail of each measurement plot 

A zoom of the graph is possible using the mouse. This is possible only if one or both boxes "Zoom X and Y Zoom" is checked. Indeed, in this case the passage of the mouse cursor over the figure changes its shape. The form taken by the cursor is +.

Two options available to you to zoom the graph:

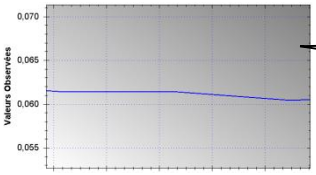
1) You use the mouse wheel

2) Or holding down the left mouse button, you select a chart area. Release the left mouse button causes a zoom selection.

11.4.3.1 Frame: Marks

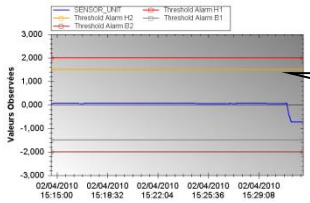
This frame consists of two check boxes that are "grid and alarm."

If this check box is ticked, a grid is displayed on the graph.



Grid displayed on the graph

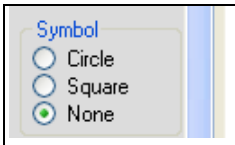
If this check box is ticked, all the alarms threshold H1/H2/L1/L2 are displayed on the graph

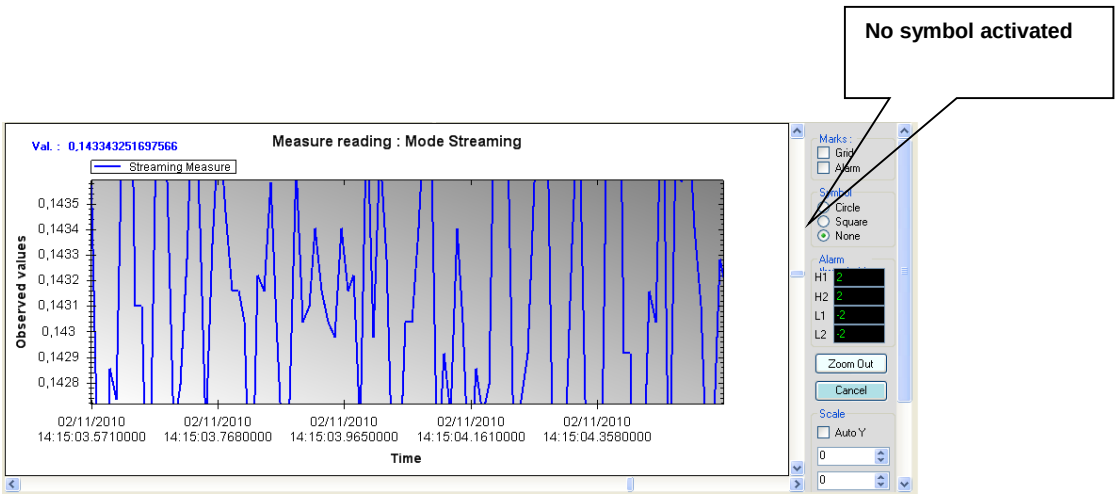


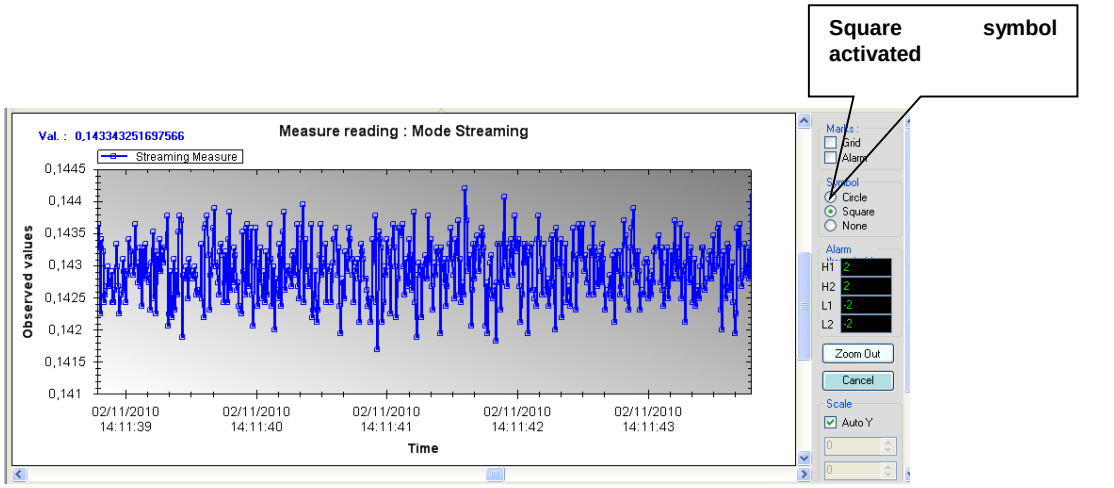
Alarms threshold H1/H2/L1/L2 are displayed on the graph

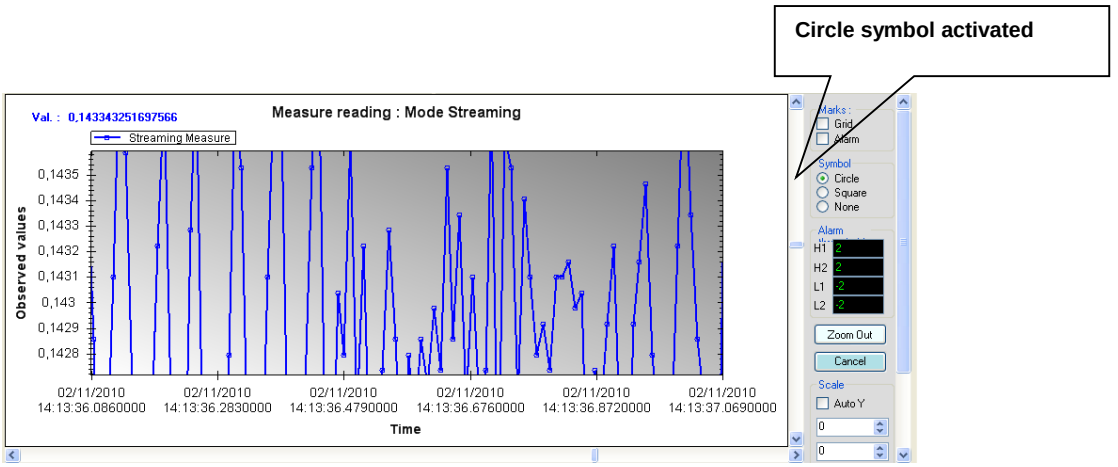
11.4.3.2 Frame: Symbols

From this frame you can select the display mode of action of the chart. Three types of symbols are available:

	***Circle***: Brings up a point on each bar graph ***Square***: brings up a square on each measure of the graph ***None***: No logo is displayed on the graph

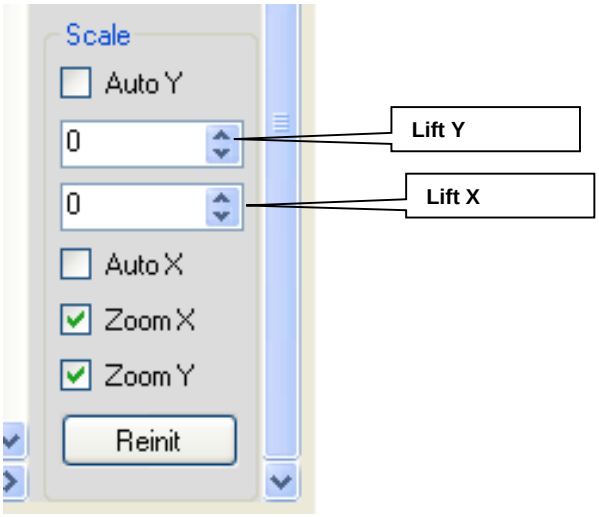

No symbol activated
Val. : 0,143343251697566
Measure reading : Mode Streaming
Streaming Measure
Observed values
0,1435
0,1434
0,1433
0,1432
0,1431
0,143
0,1429
0,1428
02/11/2010 14:15:03.5710000
02/11/2010 14:15:03.7680000
02/11/2010 14:15:03.9650000
02/11/2010 14:15:04.1610000
02/11/2010 14:15:04.3580000
Time
Marks :
Grid
Alarm
Symbol
Circle
Square
None
Alarm
H1
H2
L1
L2
Zoom Out
Cancel
Scale
Auto Y


Square symbol activated
Val. : 0,143343251697566
Measure reading : Mode Streaming
Streaming Measure
Observed values
0,1445
0,144
0,1435
0,143
0,1425
0,142
0,1415
0,141
02/11/2010 14:11:39
02/11/2010 14:11:40
02/11/2010 14:11:41
02/11/2010 14:11:42
02/11/2010 14:11:43
Time
Marks :
Grid
Alarm
Symbol
Circle
Square
None
Alarm
H1
H2
L1
L2
Zoom Out
Cancel
Scale
Auto Y


Circle symbol activated
Val. : 0,143343251697566
Measure reading : Mode Streaming
Streaming Measure
Observed values
0,1435
0,1434
0,1433
0,1432
0,1431
0,143
0,1429
0,1428
02/11/2010 14:13:36.0860000
02/11/2010 14:13:36.2830000
02/11/2010 14:13:36.4790000
02/11/2010 14:13:36.6760000
02/11/2010 14:13:36.8720000
02/11/2010 14:13:37.0690000
Time
Marks :
Grid
Alarm
Symbol
Circle
Square
None
Alarm
H1
H2
L1
L2
Zoom Out
Cancel
Scale
Auto Y

11.4.3.3 Frame : Scale

From this frame, you can customize the scaling of your graphics to suit your needs.



Check box "Auto Y" and "Auto X

- Select "Auto X" scales the X-axis automatically on the graph
- Select "Auto Y" scales Y-axis automatically on the graph

Lifts Y and X

- Where the "Auto Y" box is unchecked, you can set the limits for the graph from the field "X-lift"
- Where the "Auto X" box is unchecked, you can set the limits for the graph from the field "Y-lift"

Checkbox "Zoom X and Y Zoom"

These boxes are useful for performing a graph zoom from the mouse wheel, there are four cases:

- ***Case 1***: Case "Zoom X checked" and "Zoom Y unchecked." The graph zoom will only affect the X axis.
- ***Case 2***: Case "Zoom X unchecked" and "Zoom Y ticked." The graph zoom will only affect the Y axis.
- ***Case 3***: Case "Zoom X checked" and "Zoom Y ticked." Zoom will affect both X and Y axes
- ***Case 4***: Case "Zoom X unchecked" and "Zoom Y unchecked." The zoom function from the mouse wheel is disabled.

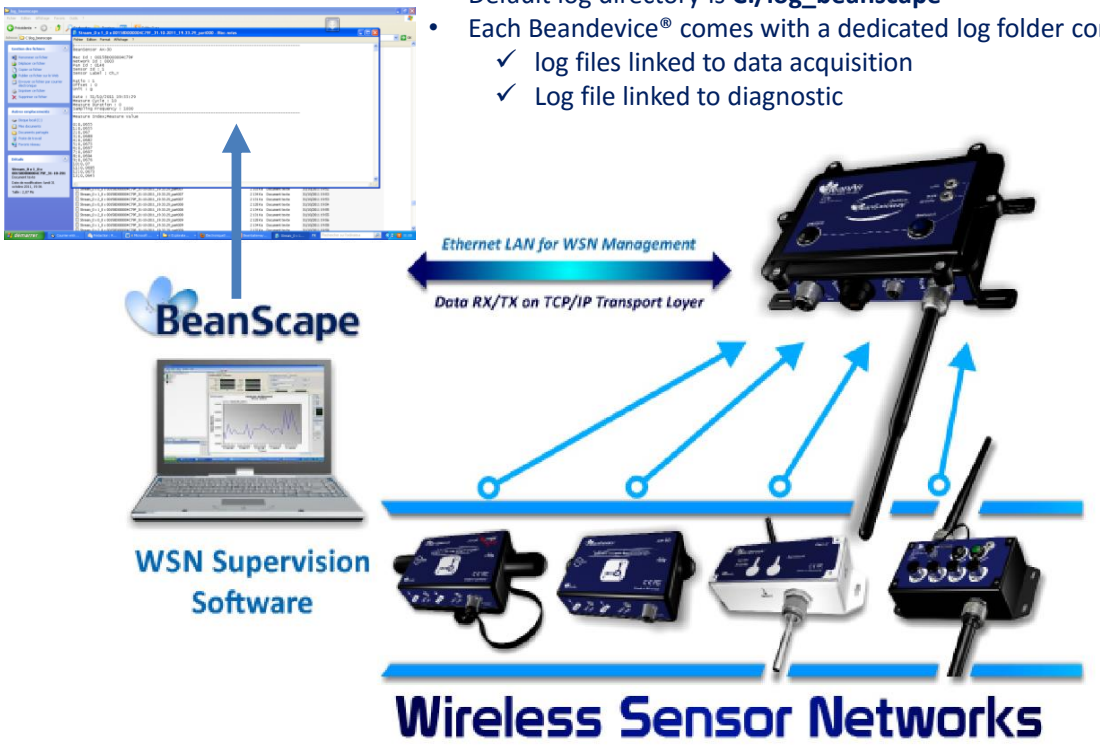
11.5 DATALOGGER CONFIGURATION

Please read the technical note TN_RF_007 – "BeanDevice® dataLogger User Guide "

11.6 LOG FILE & FOLDER ORGANIZATION (FOR EXPERIENCED USER USER)

11.6.1 Log file system overview

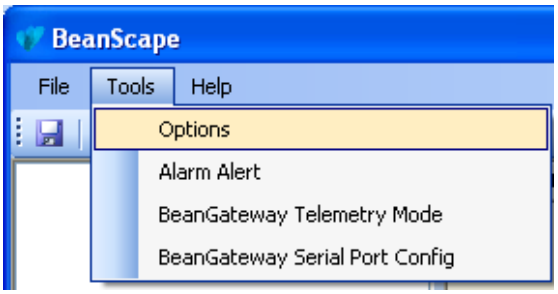
- Default log directory is **C:/log_beanscape**
- Each Beandevice® comes with a dedicated log folder containing:
  - ✓ log files linked to data acquisition
  - ✓ Log file linked to diagnostic



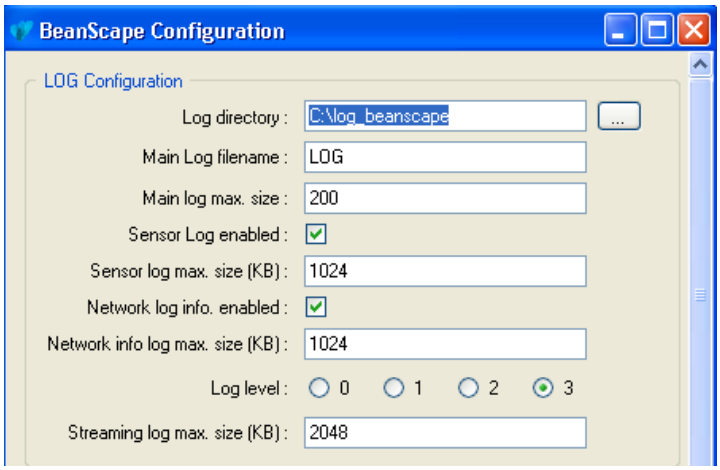
11.6.2 Log file directory

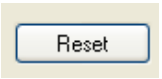
By default the Log file directory is: *C:\log_beanscape*

Click on the tab Tools then Options to configure advanced settings in *BeanScape®*:



This window lets you configure the logs, and the data cache.

- ✓ A second window is displayed:
  - 

- ✓ Clicking the button 

reverts back to its original configuration.

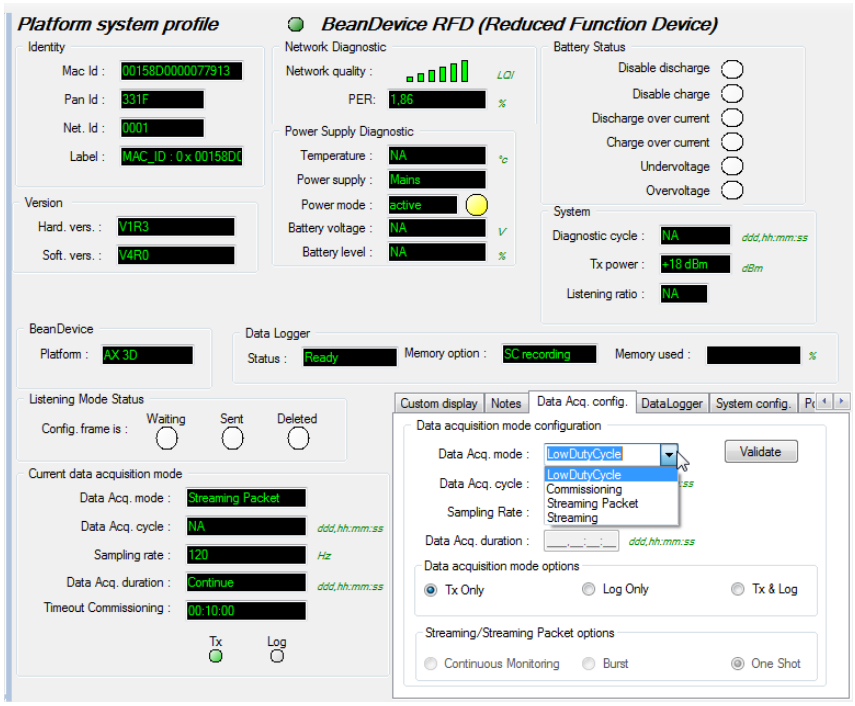
11.6.3 Log folder

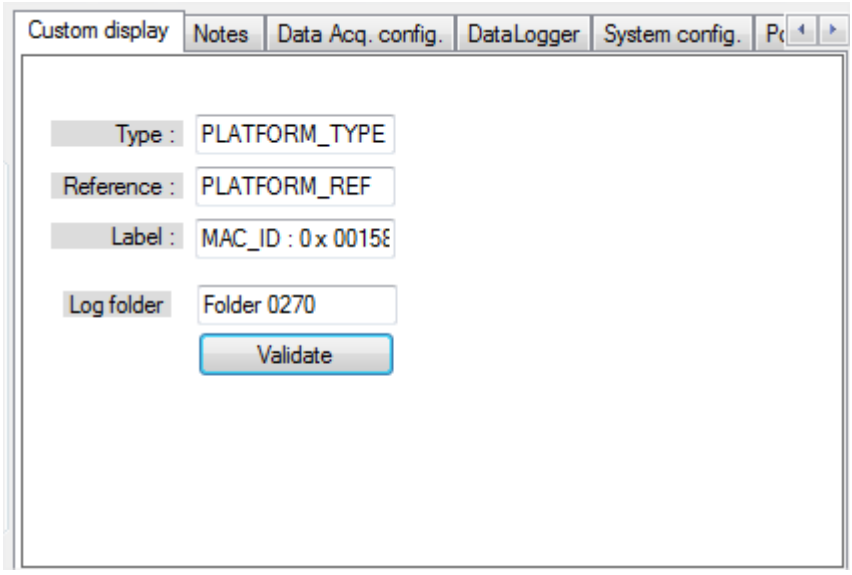
By Default log files linked to the ***Beandevice®*** are stored in the log folder (located in C:/log_beanscape directory):

"***Folder MAC_ID***"

Only the last 4 Char of BeanDevice® MAC ID are displayed.

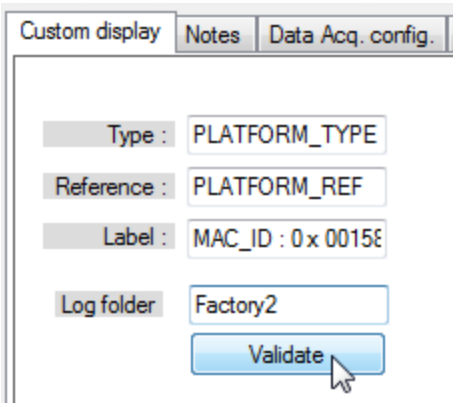
User can change log folder name by clicking on "Custom display" tab located on the **BeanDevice®** profile:



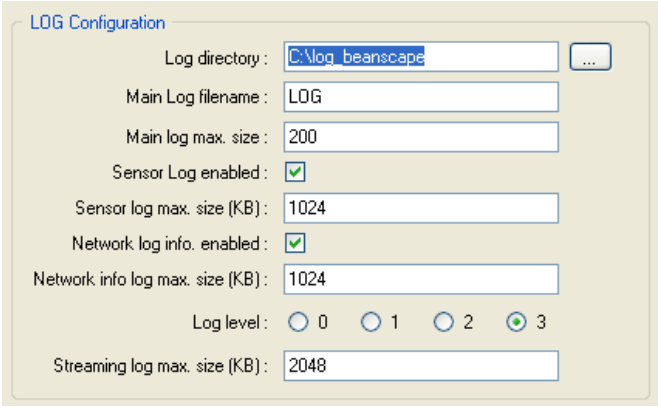


Enter your own log folder name, then click on validate.

The following example shows the log folder changed to "Factory2":



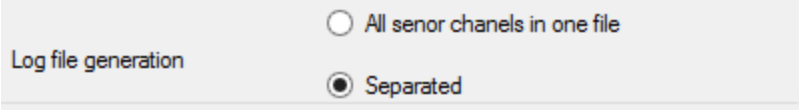
11.6.4 Log file size configuration



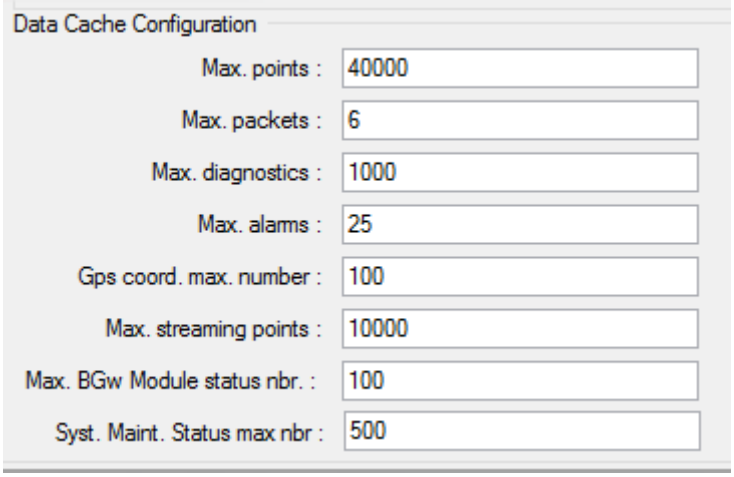
- ✓ ***LOG directory***: Enter here the path/folder where you would want to save the LOG files.
- ✓ ***Main log filename***: Here you may enter the desired name in order to save the LOG file.
- ✓ ***Main log max. size (KB):*** Maximum file size in Kilobytes (KB) for your principal LOG file
- ✓ ***Sensor Log Enabled***: Check this box if you want to enable the sensor(s) data acquisition in your LOG file
- ✓ ***Sensor log max. size (KB)*** : Maximum size in Kilobytes (KB) of sensor log files (**except** for streaming & streaming packet data acquisition mode)
- ✓ ***Network log info. enabled*** : Check this box if you want to enable network information in your LOG file
- ✓ ***Network info log max. size (KB)*** : Maximum size in Kilobytes for your network information LOG file
- ✓ ***Log level*** : Display priority LOGS
- ✓ ***Streaming log max. size :*** Maximum size in Kilobytes (KB) of sensor log files (***only*** for streaming & streaming packet data acquisition mode)

11.6.5 Log file generation

By default, 1 log file is linked to 1 sensor channel. The user can select a log file linked to all the sensor channels present on the Beandevice®.



11.6.6 Cache Data configuration (for Graph)


Data Cache Configuration
Max. points : 40000
Max. packets : 6
Max. diagnostics : 1000
Max. alarms : 25
Gps coord. max. number : 100
Max. streaming points : 10000
Max. BGw Module status nbr. : 100
Syst. Maint. Status max nbr : 500

- ✓ ***Maximum number of points***: Set here the maximum number of points displayed on the BeanScape® graph
- ✓ ***Maximum number of packets***: Set here the maximum number of packets displayed on the BeanScape® graph
- ✓ ***Max number of diagnostics***: Set here the maximum number of diagnostics displayed on the BeanScape® graph
- ✓ ***Max number of alarms***: Set here the maximum number of alarms displayed on the BeanScape® graph
- ✓ ***Maximum number of GPS coordinates***: Set here the maximum number of GPS informations;
- ✓ ***Maximum streaming points***: Set here the maximum number of points displayed in Streaming/Streaming Packet on the BeanScape® graph

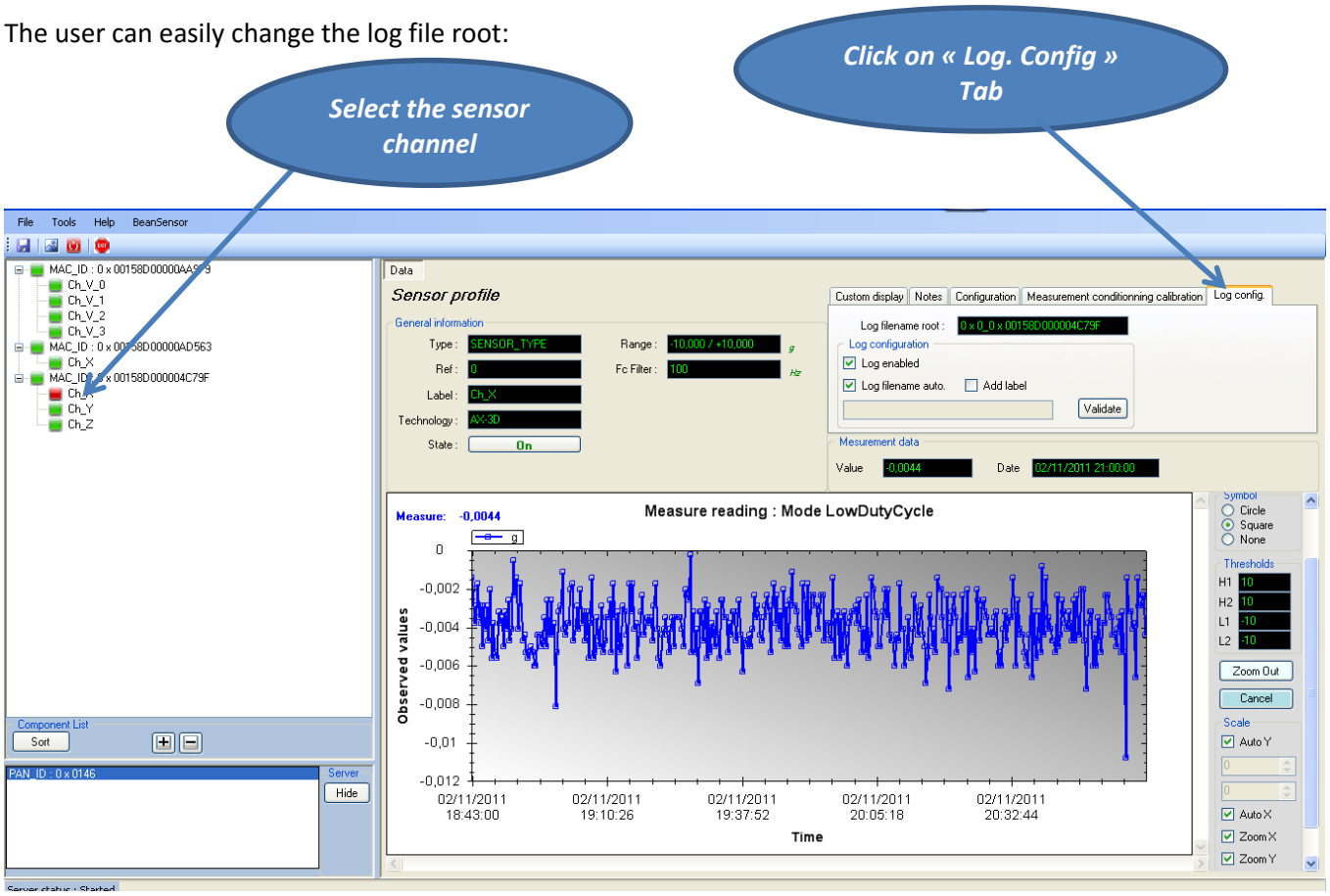
File size may affect memory capacity of your computer.

11.6.7 Log file related to data acquisition

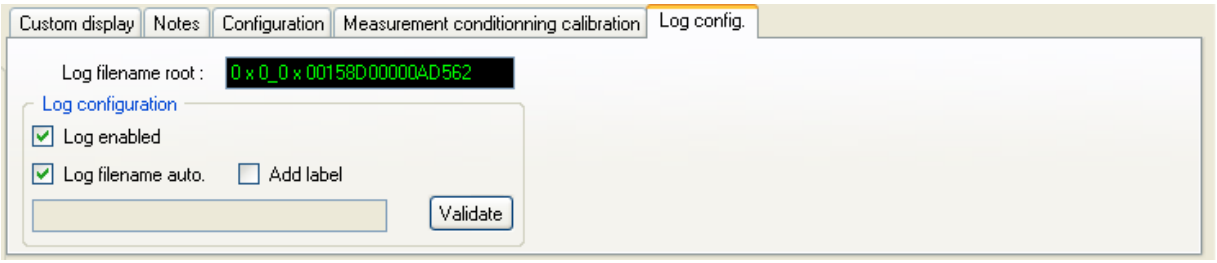
11.6.7.1 Log filename root

For each sensor channel a log file is automatically created by the BeanScape®.

The user can easily change the log file root:



This tab should not be confused with the DataLogger feature available on the Beandevice®.



By default, Log file name is built with the measurement channel & ***BeanDevice®*** MAC Address:

< Sensor Channel Number > <MAC_ID>

- ✓ ***Log enabled***: If checked, Log is enabled on the BeanScape®

- ✓ ***Log filename auto***.: If checked, Log file name is named automatically
- ✓ ***Add label***: If checked, the log file is renamed with the sensor label

Click on ***validate*** in order to validate all your modifications.

For users who want to rename the log file, two solutions are provided:

Solution 1	***Add automatically the channel "Label" in your log file name:*** ***<Label><Sensor channel Number> <MAC_ID>***
Solution 2	***The log file name can be fully customized:*** ***Uncheck the case « Log filename auto" and add your own label***

11.6.7.2 Specific case: log filename creation in "Streaming"/"Streaming Packet" mode

In streaming or Streaming packet mode, log filename is built as follow:

Stream_Sensor_channel_MAC_ID_DATE_partXXX

- ✓ ***Sensor channel = Sensor channel***
- ✓ ***MAC_ID: BeanDevice® MAC ID***
- ✓ ***DATE: date when the streaming mode starts***
- ✓ ***partXXX : Log file sequence number, part000 corresponds to the first log file***

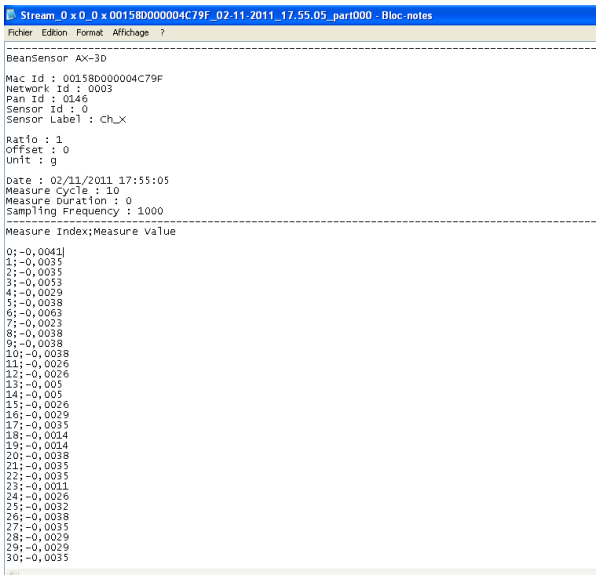
Example:

Stream_0 x 0_0 x 00158D000004C79F_02-11-2011_17.55.05_part000

Stream_0 x 2_0 x 00158D000004C79F_02-11-2011_17.55.05_part001

Stream_0 x 1_0 x 00158D000004C79F_02-11-2011_17.55.05_part001

11.6.7.3 Log file analysis



The date which is displayed in the log file corresponds to the date when the streaming mode starts.

Measure index allows the user to use a timestamp, the time value between the Index N and N+1 corresponds to the period rate.

Example: Data acquisition starts at 17h55min05s

A data acquisition with a measurement index of 30 (value -0,0035) corresponds to a time 17h55min05s30ms.

11.6.8 Log file related to Wireless Network diagnostic

11.6.8.1 Log filename organization

Wireless Diagnostic log filename is built as follow:

MAC_ID_WirelessNetwkInfo

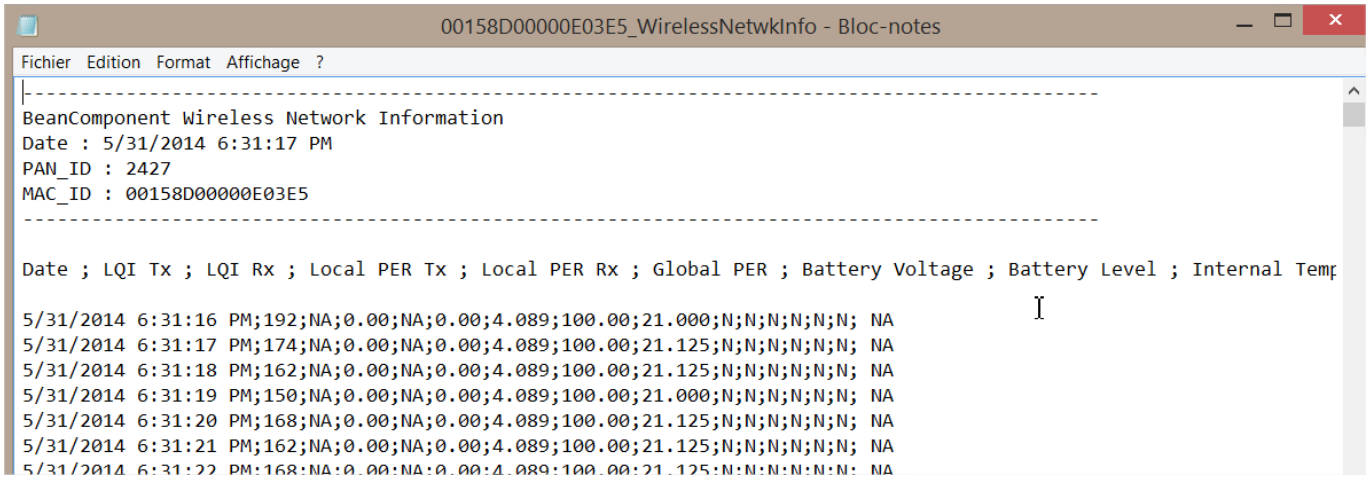
- ✓ ***MAC_ID: BeanDevice® MAC ID***
- ✓ ***DATE: date when the streaming mode starts***

11.6.8.2 Log file analysis

Log file related to wireless network diagnostic provides the following informations:

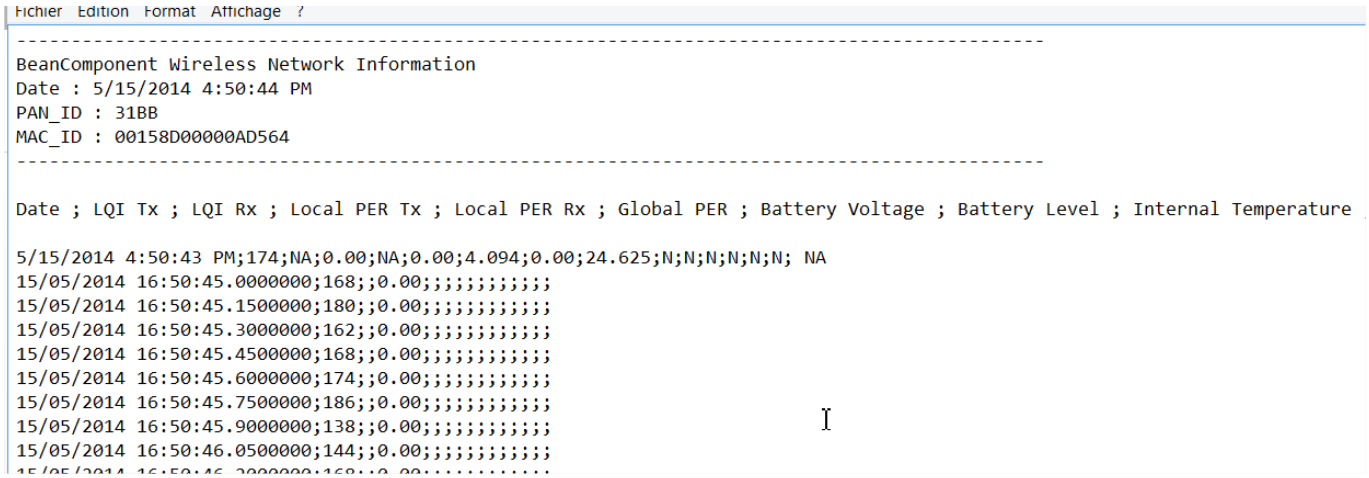
- ***Date*** : diagnostic date
- ***LQI TX***: Link quality indicator on the BeanDevice® side
- ***LQI RX***: Link quality indicator on the BeanGateway® side

- ***Local PER Tx***: Local Packet Error Rate on the BeanDevice® side
- ***Local PER Rx***: Local Packet Error Rate on the BeanGateway® side
- ***Global PER***: N.A.
- ***Battery voltage***: internal battery voltage
- ***Battery level***: battery level of charge
- ***Internal temperature***: Local temperature of the BeanDevice®


00158D00000E03E5_WirelessNetwkInfo - Bloc-notes
Fichier Edition Format Affichage ?
BeanComponent Wireless Network Information
Date : 5/31/2014 6:31:17 PM
PAN_ID : 2427
MAC_ID : 00158D00000E03E5
Date ; LQI Tx ; LQI Rx ; Local PER Tx ; Local PER Rx ; Global PER ; Battery Voltage ; Battery Level ; Internal Temp
5/31/2014 6:31:16 PM;192;NA;0.00;NA;0.00;4.089;100.00;21.000;N;N;N;N;N;N; NA
5/31/2014 6:31:17 PM;174;NA;0.00;NA;0.00;4.089;100.00;21.125;N;N;N;N;N;N; NA
5/31/2014 6:31:18 PM;162;NA;0.00;NA;0.00;4.089;100.00;21.125;N;N;N;N;N;N; NA
5/31/2014 6:31:19 PM;150;NA;0.00;NA;0.00;4.089;100.00;21.000;N;N;N;N;N;N; NA
5/31/2014 6:31:20 PM;168;NA;0.00;NA;0.00;4.089;100.00;21.125;N;N;N;N;N;N; NA
5/31/2014 6:31:21 PM;162;NA;0.00;NA;0.00;4.089;100.00;21.125;N;N;N;N;N;N; NA

If the BeanDevice® is configured with the streaming & streaming packet data acquisition mode, the following diagnostic informations are not refreshed:

- ***Battery voltage***
- ***Battery level***
- ***Internal temperature***



12. BEANDEVICE® MAINTENANCE & SUPERVISION (FOR EXPERIENCED USER)

This section allows to an experienced user to configure correctly the Wireless Sensor Networks.

12.1 EXTENDING BATTERY LIFE

The battery autonomy depends on several parameters:

- ✓ The environment where the BeanDevice® is deployed
- ✓ Data acquisition mode which is configured

The table below presents the BeanDevice® current consumption during radio TX or during sleep phase:

BeanDevice® version	*Current consumption during radio TX at 25°C, powered by a battery of 3.6V*	*Current consumption in sleep phase at 25°C, powered by a battery of 3.6V*
BeanDevice® AX-3D & BeanDevice® AX-3D XRange	60-61 mA	< 30 uA
BeanDevice® HI-INC *BeanDevice® HI-INC XRange* *BeanDevice® INC*	70-73 mA	<30uA
BeanDevice® AX-3DS *BeanDevice® AX-3DS XRange*	50-55 mA	<30uA

For further information, please read the technical note "RF_TN_002 V1.0 - Current consumption in active & sleeping mode"

The following table gives you a list of recommendations in order to extend the battery autonomy of your BeanDevice®:

Influence factors on battery lifetime	Observations	Recommendations
Sleeping power mode on your BeanDevice®	Sleeping power mode can be configured on the BeanDevice® from the BeanScape®	By activating this power mode on your BeanDevice®, you will increase the battery autonomy of your BeanDevice®. By activating sleeping power mode, the BeanDevice® current consumption can decrease from 30 mA to 10-45 micro-amperes. ***For further information, please read the technical note TN_RF_010 – « BeanDevice® Power Management »***
Sampling rate in streaming mode	Power consumption will grow with the sampling rate.	Choose the right sampling rate on your BeanScape® interface.
TX Power	Power consumption will grow with the TX Power	If your wireless range is low, try to use a lower TX Power.
Packet Error Rate (PER)	A high packet error rate can cause a higher retransmission data and this increase the current consumption.	Try to replace your BeanDevice® in an area where the radio link is much better (see Link Quality Indicator value).

12.2 OVER-THE-AIR CONFIGURATION (OTAC) PARAMETERS BACKED UP ON FLASH

The BeanDevice® integrates an internal flash memory used for backing up OTAC (Over-the-air configuration) parameters.

This memory is organized into several levels:

Level 1	• End-user parameters
Level 2	• Sensor calibration coefficients
Level 3	• Network maintenance (only fo experts)
Level 4	• Battery/Primary cell calibration

12.2.1 Level 1: End-user OTAC parameters

The following table presents all the defaults configuration parameters:

Parameter	*BeanDevice® version*		
	AX3D & AX-3D Xrange	HI-INC & HI-INC XRange	*AX-3DS* & *AX-3DS* XRange
Power Mode	*Active*	*Active*	*Active*
Data Acquisition duty cycle	*10s*	*10s*	*10s*
Acquisition duration time	*OK*	*OK*	*OK*
Sampling rate	*OK*	*OK*	*OK*
Data Acquisition mode	*LowDutyCycle*	*LowDutyCycle*	*LowDutyCycle*
TX Power	*+18dBm*	*+18dBm*	*+18dBm*
Alarms Threshold	*H1 :2 ou10* *H2 :2 ou 10* *S2 :-2 ou -10* *S1 :-2 ou -10*	*H1 :20* *H2 :20* *S2 :0* *S1 :0*	*H1 :20* *H2 :20* *S2 :0* *S1 :0*
Anti-aliasing Filter cut-off frequency	*100 Hz*	*10 Hz*	*10 Hz*

Table 3: End-user OTAC parameters

To restore these defaults parameters, you must perform a ***Network context deletion***.

The "**Network**" non-contact button is outside the product. Hold the magnet on the button network ("Network") for more than 2 seconds.

Level 2, 3 & 4 of Configuration parameters are not affected by network context deletion (by hardware or software)

12.2.2 Level 2: Sensor calibration parameters

The table below presents the sensor calibration parameters depending on BeanDevice® version:

Parameter	*BeanDevice® Version*		
	AX3D & AX-3D Xrange	HI-INC & HI-INC XRange	*AX-3DS* & *AX-3DS* XRange
Sensor gain	OK	OK	OK
Sensor offset	OK	OK	OK

12.2.3 Level 3: Network maintenance (only for expert in wireless sensor networks)

The table below presents the network maintenance parameters depending on your BeanDevice® version:

Parameter	BeanDevice® version		
	AX3D & AX-3D Xrange	HI-INC & HI-INC XRange	*AX-3DS* & *AX-3DS* XRange
Software reset counter	OK	OK	OK
Physical reset counter	OK	OK	OK
Threshold value on software reset	OK	OK	OK

12.2.4 Level 4: Primary cell/Rechargeable battery calibration

The table below presents Primary cell/rechargeable battery calibration depending on BeanDevice® version:

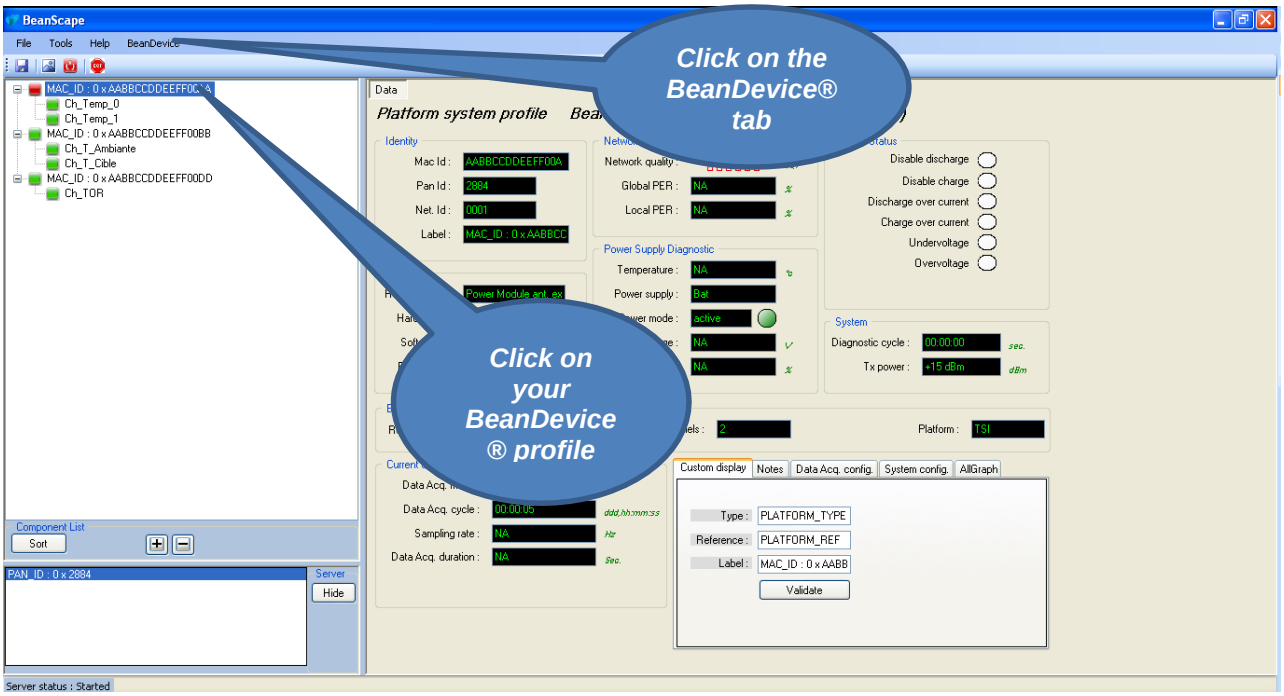
Parameter	*BeanDevice® version*		
	AX3D & AX-3D Xrange	HI-INC & HI-INC XRange	*AX-3DS* & *AX-3DS* XRange
Battery, primary cell ID	OK	OK	OK
Battery, primary cell calibration	OK	OK	OK

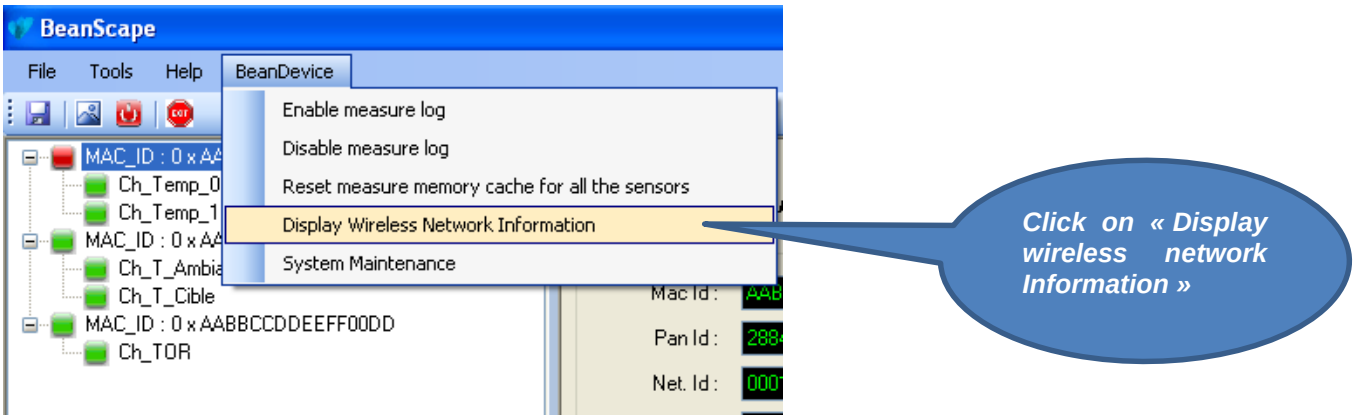
12.3 NETWORK DIAGNOSTIC FROM YOUR BEANSCAPE® SOFTWARE

The BeanScape® provides network diagnostic information which is described in this chapter.

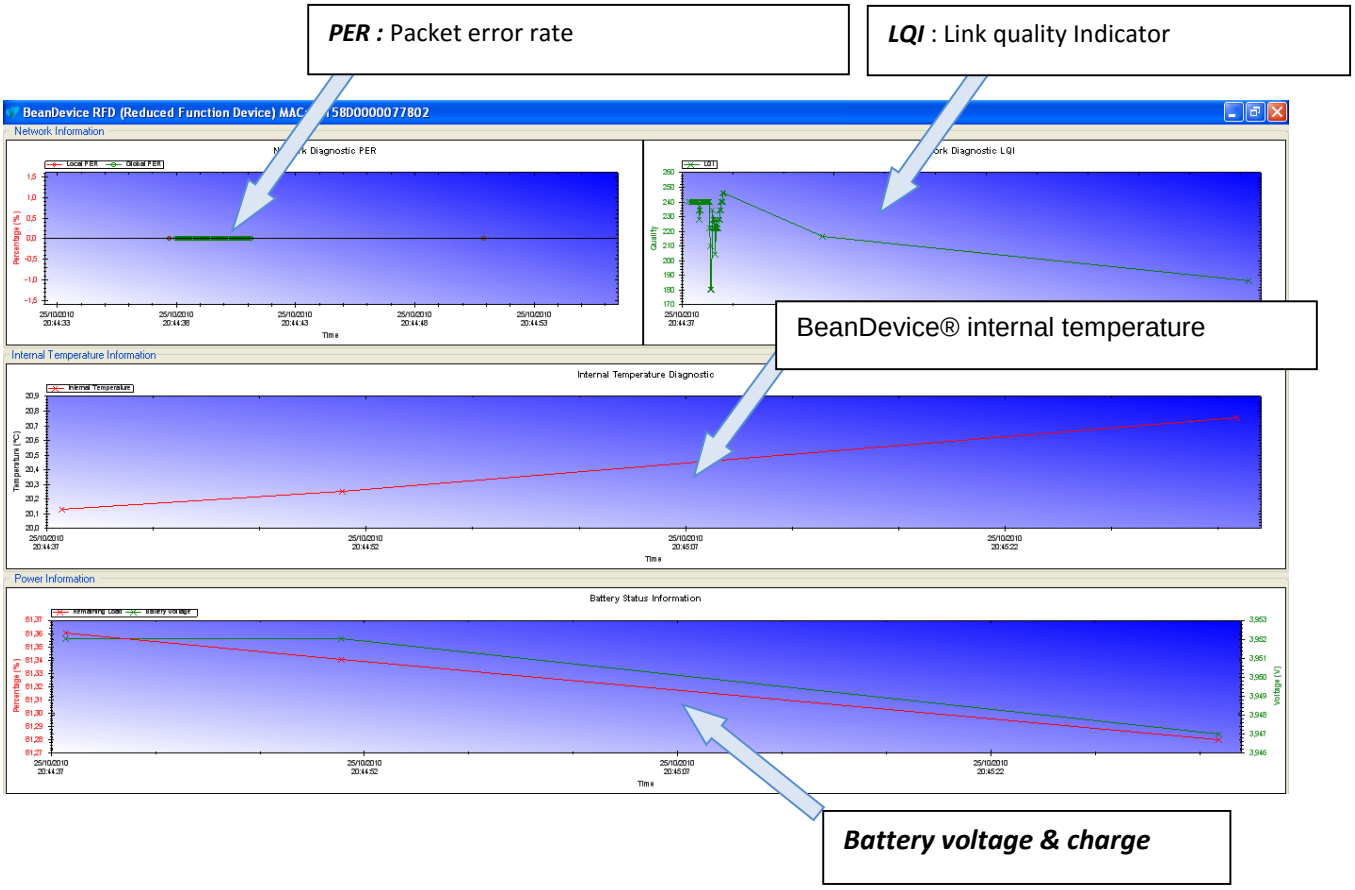
12.3.1 Displaying Network information

1. Launch your BeanScape® application
2. Select your BeanDevice® profile, a new tab "BeanDevice" will appear in your BeanScape® toolbar;
3. Click on this tab, and then click on "View History Network".





A new window occurs:



12.3.1.1 Packet Error Rate

Packet error rate (PER) is the number packet errors divided by the total number of transferred packet during a studied time interval. PER is a unit less performance measure, often expressed as a percentage number.

PER is only available with IEEE 802.15.4 Network, it represents the ratio of "lost data/data send" between the BeanDevice® and the BeanGateway®.

12.3.1.2 LQI (Link Quality Indicator)

LQI (Link Quality Indicator) represents the radio signal quality in your Environment. It is possible that LQI is low due to EMC interference or metal presence in the environment.

If you encounter such problems, several solutions are proposed to increase your LQI:

- ✓ Use the Maximum TX Power on your BeanDevice. The maximum TX Power authorized in Europe for indoor application is 12 dBm. For Outdoor application, you are authorized to extend the TX Power to 18 dBm. You can easily configure the TX Power on your BeanDevice from your BeanScape WSN software supervision.

- ✓ Try to configure your receiver antenna and your transmitter antenna on the same antenna pattern (cf. the Beam with of your antenna)
- ✓ Use a high gain antenna (in outdoor use only) for a better RF Link Budget
- ✓ Fix your BeanDevice & BeanGateway on a top of a mast or a building.

For further information, read the application note on "How to extend your wireless range?"

12.3.1.3 Internal temperature monitoring

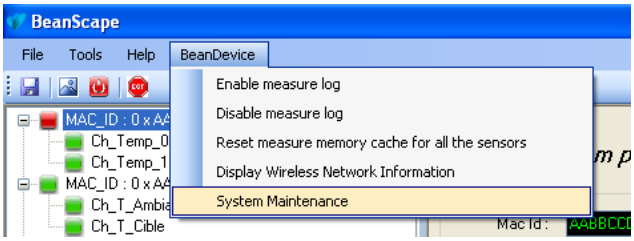
An internal temperature sensor is used for onboard & battery temperature monitoring

12.3.1.4 Battery charge monitoring

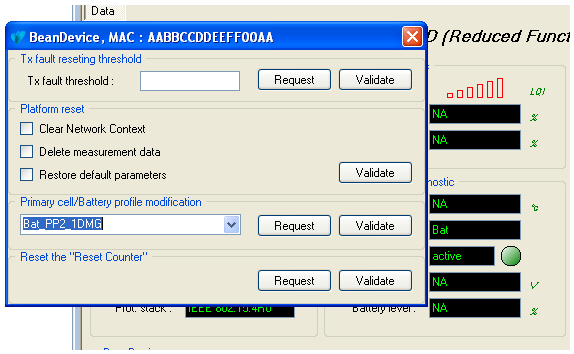
Battery charge is based on current accumulation. The BeanDevice® integrates a current accumulator circuit which facilitates remaining capacity estimation by tracking the net current flow into and out of the battery. Current flow into the battery increments the current accumulator while current flow out of the battery decrements it.

Voltage measurement corresponds to battery voltage.

12.3.1 System maintenance



Warning: This area is reserved for persons with extensive experience in Wireless sensor networks. Configuring wrongly on such an interface may cause malfunction your BeanDevice®.

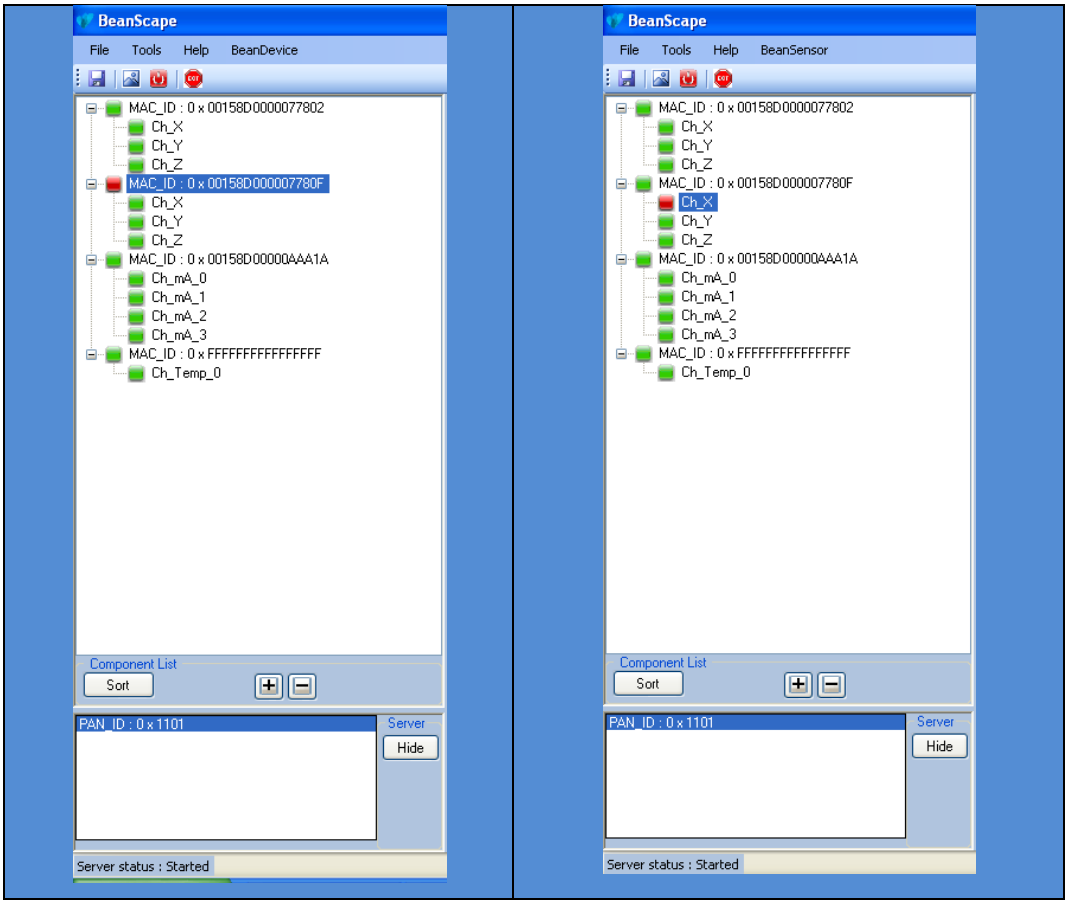


- ***TX Fault Threshold***: Not available
- ***Clear Network context (software)*** : This option may be substituted for the push button "Network". However, when the BeanDevice ® is not available (not powered or in sleeping mode) this option is not usable.
- ***Delete measurement data***: Delete stored measurements.
- ***Restore default parameters***: This function restores all the default parameters stored on the BeanDevice flash memory
- ***Primary Cell/Battery profile modifications*** : You can change your primary cell / battery profile here;
- ***Reset the « Reset counter »*** : resets the reset counter which is used for BeanDevice reboot ;

12.3.1 Scrolling menu « BeanSensor »

The BeanSensor® scrolling menu provides access to additional features: like the multi-graph mode (display of multiple windows on a graph measuring the same screen), deleting graphs displayed and the activation / deactivation of logging measurements.

To access to this scrolling menu, click on the sensor attached to your BeanDevice®. You will then see the BeanSensor® scrolling menu appearing.

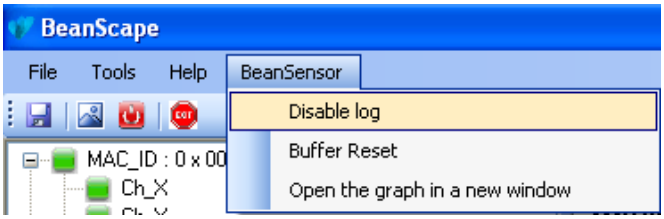


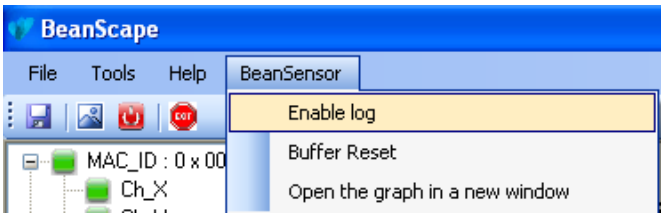
By clicking on the scrolling menu « BeanSensor », you can access to the following features :

12.3.1.1 Disable/Enable log

All the data received on the BeanScape® are stored in a log file in CSV format.

This feature allows you to enable / disable data logging on your log file.





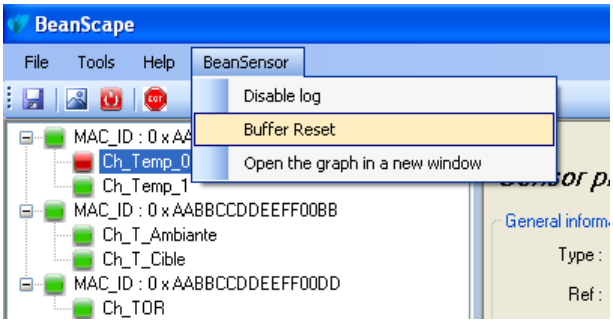
For further information about CSV log file, please read the BeanScape® user manual.

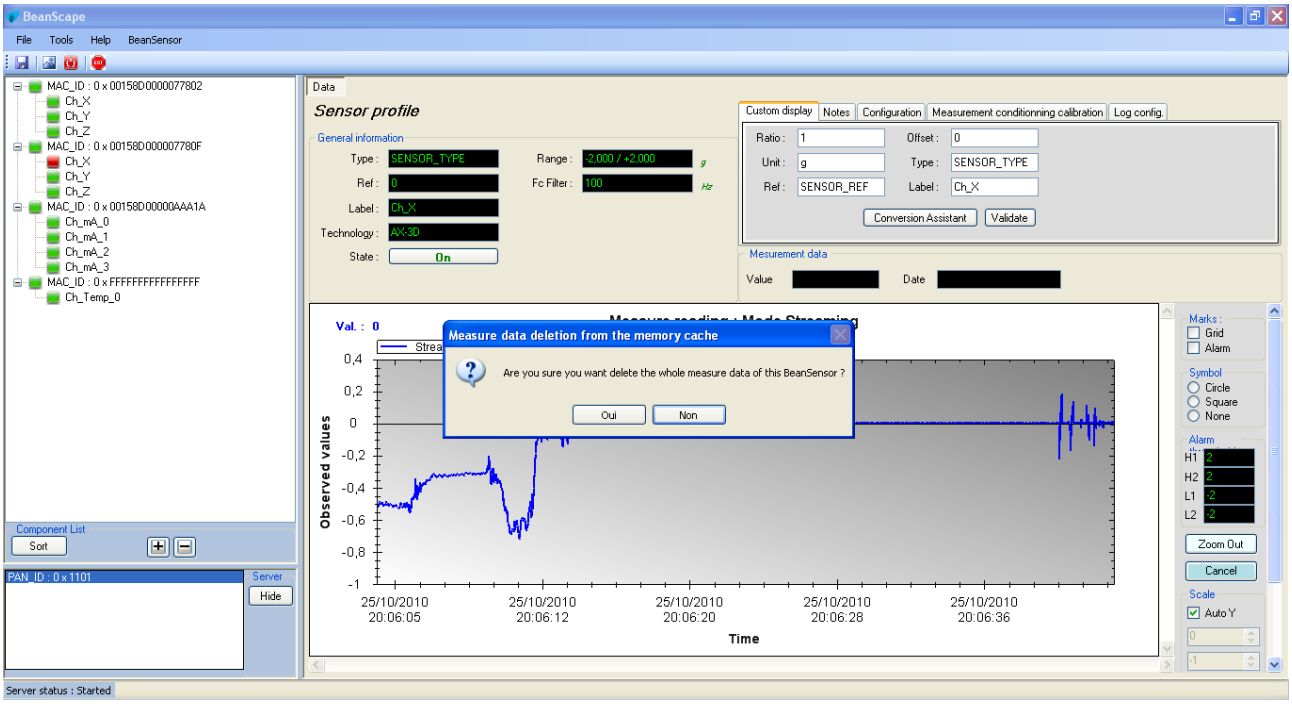
12.3.1.2 Buffer reset

This function clears the graphical display concerning recorded measurements of your sensor. The data stored in a log are not affected by this function.

By clicking on « Buffer reset », a second window appears asking you to confirm your choice:

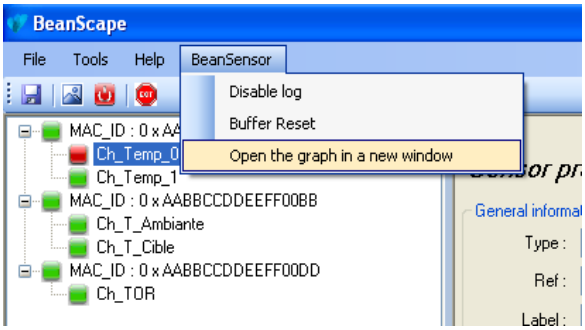
- Yes, you accept to delete the whole measure data of this BeanSensor;
- No, don't delete the whole measure data of this BeanSensor;



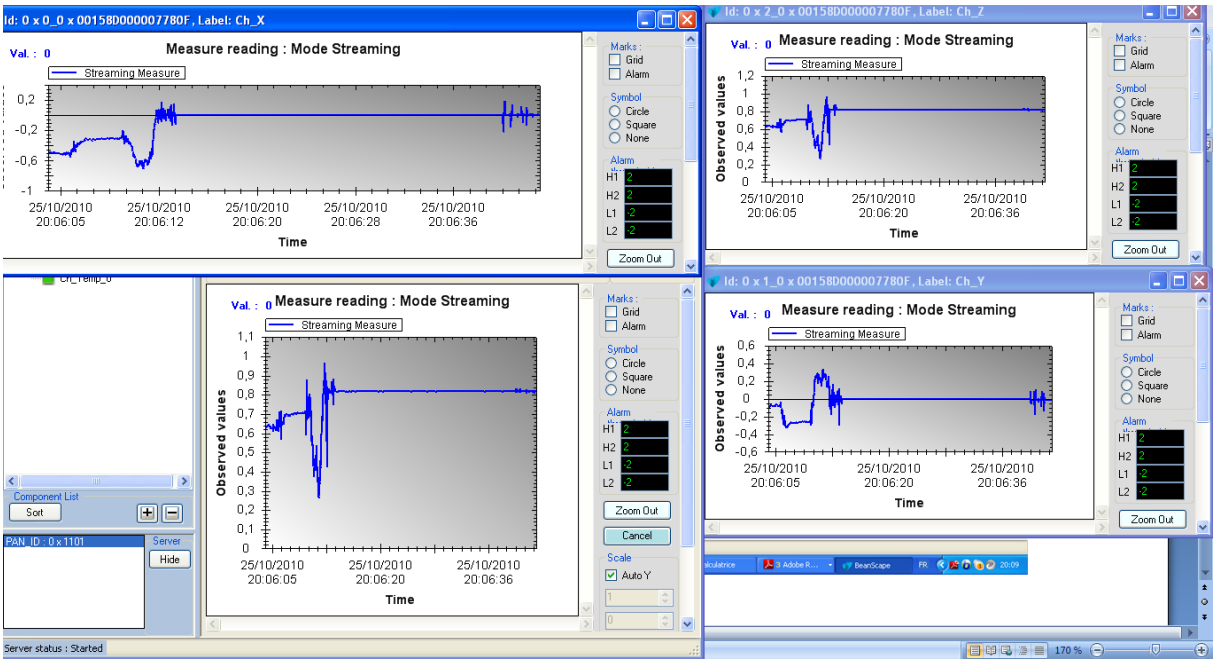


12.3.1.3 Open the graph in a new window

By clicking on "Open the graph in a new window", you can open a graph corresponding to your sensor.



You can easily open several graphs in a window.



The multi-graph mode requires a lot of resources on your computer, it is recommended to install the BeanScape® software on a powerful computer.

13. TROUBLESHOOTING

✓ ***Why the Red LED is flashing?***

Each time a packet is lost by the BeanDevice®, Nwk/Activity led will blink in red. Try to decrease the wireless range between the BeanGateway® and the BeanDevice®.

✓ ***Why the BeanDevice® LEDS are not activated?***

If there is no wireless network activity, the led will be inactive. Make sure you have powered your BeanDevice® with a charged battery.

✓ ***What should I do if interference is present on the radio channel?***

Please turn off your BeanDevice ®, and then choose an appropriate channel. The channel selection is done from the BeanGateway ®.
For further information, please Read BeanGateway User's Manual BeanGateway ®.

✓ ***Why the BeanDevice® does not provide the right measurement value?***

- Check if your sensor channel is activated on your BeanScape® interface (ON Position)?;
- Check if your BeanDevice® is powered up;
- Check your LQI quality, if your LQI is under 50-60. You must change your antenna position, or your product position;
- Check your data acquisition mode, maybe you have specified a data acquisition which is too long ;
- If you use a BeanDevice® AN-XX :
  - Check your sensor power supply, maybe you need to increase/decrease your power supply;
  - Check your sensor preprocess time. Maybe your sensor preprocess time is too short ?
  - Check the wiring code of your sensor plug ;

Why the BeanDevice® doesn't respond when I try to configure it (Over-the-air-configuration)?

✓ If your BeanDevice® operates with sleep phase, the RF Hardware operates also with a sleep phase. Therefore an Over-the-air-configuration will not be possible.

✓ Check the LQI (Link Quality Indicator) value, if this value is under 80, the over-the-air configuration will not be easy. Try to decrease the wireless range between the BeanDevice® and the BeanGateway®.

✓ If your BeanDevice® works in streaming mode, in order to keep a full synchronization of the data acquisition, any over-the-air-configuration is authorized.

Why do I have too much noise on my sensor signal ?

- ✓ If you use a BeanDevice® AX3D/HI-INC/AX-3DS : don't forget to configure the cutoff frequency of your anti-aliasing filter
- ✓ If you use a BeanDevice® AN-mV: use a shielded cable.

14.INSTALLATION PROCEDURES

14.1 SEALING

The product BeanDevice® comes with an ***IP66*** rating. So, do not install the BeanDevice® in a marine environment with high turbulence.
If you use the BeanDevice® AN-XX/TSI/TH, do not install the BeanDevice® up front to prevent the accumulation and infiltration of water from the front of the case.

14.2 COEXISTENCE WITH OTHERS FREQUENCIES AT 2.4 GHZ

The BeanDevice® is sensitive to noise 2.4GHz (Wi-Fi as a source for example), but many protections are already in place, particularly in the IEEE 802.15.4®.
It should however be careful when installing the product, check all the possibilities of radio channels on the frequency range 2.4-2.5GHz. The operation of the product will be improved.

For further information, read the application note: AN_RF_004 – "Coexistence And Interferences@2.4GHz"

14.3 TEMPERATURE & HUMIDITY

The BeanDevice® smartsensor series comes with an operating temperature of -20°C to +65°C.

BeanDevice® products can operate in an area with 90% humidity.
However, the wireless range can be reduced in the presence of water. Avoid mounting the BeanDevice® in an enclosure surrounded by water, or near bushy plants (plants are composed of 90% water), ...

14.4 REFLECTIONS, OBSTRUCTIONS AND MULTIPATH

For further information, read the application note: AN_RF_007 :" Beanair_WSN_Deployment"

14.5 SHOCK & VIBRATION RESISTANCE

Shock resistance on BeanDevice® products are:

BeanDevice® Type	*Shock resistance*
BeanDevice® AX-3D	50g during 50 ms
BeanDevice® AX-3DS	50g during 50 ms
BeanDevice® HI-INC	50g during 50 ms

Do not force connections.

14.6 ANTENNA

Check the LQI (Link Quality Indicator) of your BeanDevice® for being sure that your antenna is right oriented.

For further information, read the application note: AN_RF_007 :" Beanair_WSN_Deployment"